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THE SUBSTITUTE BLADDER

A REPORT OF FIVE CASES

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IN 1950 Bricker and Gilchrist independently described an operation for making a substitute urinary bladder by isolating portion of the ascending colon and terminal ileum and transplanting the ureters into the former. The stump of ileum was brought out on the abdominal wall and acted as an "urethra," while the colon served as a receptacle for urine. Bowel continuity was restored by ileo-colonic anastomosis. The presence of the ileo-caecal valve in the isolated segment offered the possibility of continence. Bricker, who utilized little more than the caecum, reported that true continence was not achieved, but Gilchrist, using a larger amount of ascending colon, obtained a capacity of 210 mils and stated that his case was continent.

After considerable discussion in the Radio-Surgical Unit at the Women's Hospital, it was felt that this procedure offered many possible advantages, particularly in avoiding the disabilities of a "wet" colostomy, and it was decided to attempt the operation as occasion arose. At the time of writing, the operation has been carried out five times, and the observations made to date are reported.

CASE REPORTS

Case 1

E.P., aged 40, had been treated in October, 1951, by radon for a Stage II carcinoma of the cervix. In March, 1952, there was fairly massive residual growth in the pelvis with bladder and bowel involvement. Pyelography revealed no abnormality. On 10th April, 1952, a substitute bladder was made, using the ascending colon as far as the hepatic flexure, rotating it transversely and fixing it in the posterior abdominal parietes just above the sacral promontory. The six-inch terminal ileal stump was brought through the abdominal wall 2 inches to the right of the umbilicus. Urinary excretion was depressed for the first thirty-six hours but then became satisfactory. At this stage great difficulty was encountered in keeping the large catheter free from blockage with mucus, which was secreted in large amounts. The error was then made of changing the catheter at frequent intervals, and this resulted in a disaster, the nature of which was made clear by the subsequent autopsy. The manipulations had caused the sutures fixing the substitute bladder to give way, and there had occurred what can perhaps be best described as a volvulus. This had resulted in over-distension with urine and leakage at the site of implantation of the left ureter, which at operation had been found to be thin-walled and dilated. Death occurred on 18th April, 1952.

In consequence of this happening it was felt that it would be better to defer implantation of the ureters until the isolated colonic segment had healed firmly in its new position. This would also permit washing out of the substitute bladder and further sterilization by means of antibiotic suspensions before transplanting the ureters.

Case 2

A.H., aged 63, presented with advanced carcinoma of the vulva involving the bladder and anus, and over-flow incontinence. Pyelography showed no abnormality on the left side, by on the right side demonstrated double ureters and renal pelves with considerable dilatation.

On 3rd July, 1952, a substitute bladder was constructed as above, but without implanting the ureters. Wash-outs were begun on 12th July, and from 27th July these were followed by daily instillations of a suspension of phthallyl-sulphathiazole. On 29th July the ureters were anastomosed to the substitute bladder by the Coffey method. It was found that the two ureters on the right side united just above the point at which ureteric

section was to be made, so that a double implantation on that side was not necessary. Urinary excretion was rapidly established, and on 6th August the catheter was removed and intermittent catheterization carried out thereafter. She was discharged from hospital on 23rd August. Death occurred four and one half months later from widespread metastases, but in the meantime the substitute bladder with 2-3 hourly catheterization, had proved to be continent and was easily managed by the patient.

FIG. I. Case 3. L.B. Pelvic contents *en bloc*. The bladder is bisected and the uterus, cervix and vagina laid open. Squamous carcinoma replaces the uterus, cervix and upper half of vagina, converting them into a solid tube without demarcation. The muscular walls of the bladder and rectum are invaded. All the pelvic lymph nodes (not shown), except the right common iliac group, contained metastases.

Case 3

L.B., aged 58, had received treatment by radon in March, 1949, for a carcinoma of the cervix uteri. In August, 1952, clinical examination showed a "blocked" pelvis with considerable growth in the cervix and upper vagina. Cystoscopy demonstrated oedema of the bladder base without mucosal involvement, and pyelography showed minimal right hydronephrosis, but slightly more dilatation on the left side.

The Honorary Radiotherapist at the Women's Hospital, Dr. W. P. Holman, who has had considerable experience in gastric irradiation directed to the diminution of gastric secretion, then suggested that preliminary irradiation of the ascending colon might lessen the secretion of mucus. On theoretical grounds he proposed a dosage of 1500 r. over three weeks. This procedure was carried out from 25th August to 12th September, 1952, after preliminary localization of the caecum and ascending colon by means of a barium swallow. On 26th September, a substitute bladder was made, again utilizing the ascending colon as far as the hepatic flexure.

Convalescence was interrupted by pulmonary atelectasis and bronchopneumonia, and the second operation was not carried out until 21st November. This consisted of total pelvic exenteration as described by Brunschwig (1948), and implantation of the ureters into the previously constructed substitute bladder. The catheter was removed on 30th November and intermittent catheterization commenced. This was carried out at first at intervals of one and a half hours, but within a fortnight it was found that with three-hourly emptying continence was absolute. On 19th December, pyelography showed bilateral hydronephrosis, the blood urea was 20 mgm. per 100 mils, and the serum chlorides 549 mgm. per 100 mils. She was discharged from hospital on 24th December, at which time she had trained her colostomy to act daily at the same time, and managed her substitute bladder easily with three-hourly catheterization. Her body weight, which pre-operatively had been 164 pounds, had fallen to 117 pounds, but she felt well and her morale was excellent. Endoscopy of the substitute bladder showed what appeared to be healthy bowel mucosa.

On 13th January, 1953, the serum chlorides were 603 mgm. per 100 mils, the blood urea 22 mgm. per 100 mils, and she looked and felt well. On 27th January, he body weight was 127 pounds, the daily urinary output was 1500 mils, the substitute bladder easy to manage, and she had reached the stage of going out to play cards.

On 18th February, her body weight was 138 pounds, blood urea 21 mgm. per 100 mils, and serum chlorides 547 mgm. per 100 mils. On 13th May, pyelography showed improvement in the degree of hydronephrosis on both sides, especially on the right side. The capacity of the substitute bladder was found to be 360 mils. Her body weight had increased to 148 pounds. Serum chlorides were 585 mgm. per 100 mils.

She has remained symptom-free to the time of writing (1st November, 1953), does her own cooking and washing, and is able to dine out and attend theatres. The colostomy acts once daily at the same hour. She is continent with 2-3 hourly catheterization and wears no apparatus. Her body weight is now stationary at 168 pounds. Pyelography on 1st October, 1953, showed minimal dilatation on the

right side and further improvement on the left side. Plasma analysis on the same date gave the following values—Serum Sodium 138 M/Eq per 100 mils, Chloride 109 M/Eq per 100 mils, Potassium 8.0 M/Eq per 100 mils, and HCO_3 26 M/Eq per 100 mils.

Case 4

V.M., aged 62, had received treatment for a Stage II carcinoma of the cervix in 1947 by radon and deep X-ray therapy. Residual disease was proven by biopsy and similarly treated in 1951. In February, 1953, a growth was found occupying the upper vagina and involving the middle third anteriorly. A large mass with very slight mobility filled the pelvis, and a nodule was felt in the right utero-sacral ligament. Cystoscopy showed gross nodularity and congestion of the bladder base, but the mucosa was not ulcerated. Pyelography revealed no abnormality. Her body weight was 135 pounds.

FIG. II. Case 4. V.M. Operation Specimen. Similar to Case 3. Unfortunately, the specimen was partly spoiled through having inadvertently been left almost entirely unfixed for eighteen hours. In this case none of the pelvic lymph nodes (not shown) contained metastases. Rod in left ureter.

Despite the heavy emphasis which was laid on the risks, complications, and possible disabilities of surgery, she elected to undergo operation, and, after preliminary irradiation of the ascending colon, 26th February to 18th March, a substitute bladder was constructed on 30th March. On 26th May, total pelvic exenteration was carried out, the ureters were implanted into the substitute bladder, and a terminal left iliac colostomy was formed.

On 1st July, the blood urea was 18 mgm. per 100 mils and the serum chlorides 573 mgm. per 100 mils. She was discharged from hospital on 9th July, the substitute bladder being continent with 3-hourly catheterization, and her body weight being 120 pounds. Pyelography showed left sided hydronephrosis, but the right side was normal.

On 13th October, the blood urea was 20 mgm. per 100 mils and the serum chlorides 585 mgm. per 100 mils. She looked and felt well, the substitute bladder remained continent and was easily managed, but she had not succeeded in training her colostomy as successfully as L.B., and she was wearing a colostomy bag.

Case 5

E.F., aged 65, was seen on 21st May, 1953, for the first time with the following history. She had been treated in 1930 by radium followed by hysterectomy, presumably for carcinoma of the cervix uteri. In December, 1951, a small squamous carcinoma had appeared low down on the posterior vaginal wall and had been treated by radon. This was followed by the development of a recto-vaginal fistula, for which a sigmoid colostomy had been performed, but within a short time a vesico-vaginal fistula developed. A laparotomy undertaken with the object of making a "wet" colostomy was abandoned, apparently because of pelvic adhesions.

Pyelography showed poor outlining of the calyces and dilatation of the left renal pelvis and ureter. Preliminary irradiation of the right colon was carried out from 22nd June to 10th July (1500 r.). On 27th July, the blood urea was 62 mgm. per 100 mils and serum chlorides 644 mgm. per 100 mils.

On 31st July, a substitute bladder was made, but on this occasion, because her poor condition did not warrant exenteration, the ureters were transplanted into the isolated segment of bowel and the operation was completed in one stage. Intermittent catheterization of the substitute bladder was commenced on 10th August at 2-hourly intervals, and two days later this interval was increased to 3-hourly, without loss of continence. Over the next few days she suffered from diarrhoea, and during this period it was found that the substitute bladder discharged urine synchronously with the bowel actions. However, as the diarrhoea abated she again became continent and has remained so to date. On 17th August, the blood urea was 30 mgm. per 100 mils and the serum chlorides 573 mgm. per 100 mils. On 10th September, 1953, these values were—blood urea 27 mgm. per 100 mils and serum chlorides 614 mgm. per 100 mils.

Her colostomy has always acted rather frequently and this has been more marked since the last operation, but despite several attacks of diarrhoea there has been no repetition of the frequent emptying of the substitute bladder.

DISCUSSION

Technique

The technique used in making the substitute bladder in the above cases has been as follows.

After mobilization of the right colon and appendicectomy, the colon is divided at the hepatic flexure and both ends are closed. The ileum is cut across approximately 5-6 inches from the ileocaecal valve and the proximal end, after closure, is brought up and anastomosed by the side-to-side method with the right extremity of the transverse colon. The isolated colonic segment is swung across in front of its blood supply so as to lie transversely at about the level of the fourth lumbar vertebra. An incision is made in the posterior parietal peritoneum at this level and the substitute bladder partially embedded by means of interrupted sutures. The ileal stump, which is to form the new "urethra" is brought directly through the abdominal wall via a small stab wound approximately 2 inches to the right of and one inch above the umbilicus. No attempt is made to obliterate the lateral gutter since it is felt to be important that the new "urethra" should be straight and under no tension. The pre-operative preparation in regard to diet, bowel wash-outs, and antibiotic therapy, follows the usual lines adopted in bowel surgery. In two-stage operations wash-outs of the substitute bladder are commenced approximately nine days after completion of the first stage. During the week preceding the second stage the wash-outs are followed by instillations of a suspension containing phthallyl-sulphathiazole, penicillin, and streptomycin. After the second stage, continuous drainage is maintained by a Foley catheter with Wangensteen suction for approximately one week, after which intermittent catheterization is instituted.

Observations

It has been found in these few cases that with little variation the average capacity of the substitute bladder is about 360 mils, and this has given continence with emptying at intervals of approximately 3 hours. The patients seem to find no difficulty in passing catheters.

It has been noted during endoscopy that at a certain distension the substitute bladder actively contracts and causes partial evacuation of its contents. Similarly, when the substitute bladder is allowed to over-distend, leakage is intermittent and sometimes quite forcible. It would seem also that the same reflex may be elicited by manipulation of the catheter. The patients soon learn this trick and make more use of it than they do of simple abdominal pressure.

Patient 4 finds that when she catheterizes her substitute bladder it usually causes her colostomy to act. As stated above, in Case 5, an attack of diarrhoea shortly after operation resulted in frequent discharge of urine from the substitute bladder in association with the frequent actions of the colostomy. This, however, ceased after a few days, and since then further attacks of diarrhoea have caused no disturbance in urinary continence.

The preliminary irradiation of the colonic segment has resulted in a striking diminution in mucus secretion and this has been of very great benefit both at the time of operation and subsequently. It has been found that after two to three months there has occurred a slight increase of mucus production, but even in Case No. 3, in whom the irradiation was carried out more than twelve months ago, the amount secreted is quite small.

Finally, at no stage in any of these cases has there been any evidence, either clinical or biochemical, of hyperchloraemic acidosis. This is interesting, because there is ample evidence in the literature that in a high proportion of cases diversion of the urinary stream to the bowel is accompanied by this complication, and because it seems to be generally agreed that it becomes increasingly common as the anastomosis is carried out at higher points in the large intestine.

There is some division of opinion as to the relative parts played in the production of this condition by re-absorption of electrolytes from the bowel and renal tubular damage respectively. Lapides (1951) considers that hyperchloraemic acidosis from re-absorption of electrolytes does not occur in the absence of renal tubular damage. Mitchell and Valk (1953), on the other hand, hold that the condition may develop in the presence of good renal function. They advise in the strongest terms that uretero-intestinal anastomosis should be made as low as possible in the bowel, and that the patients

should be warned to empty the bowel at intervals of 1-1½ hours, take a low salt diet, ingest 4½-5 litres of fluid and take 1-4 gm. of sodium bicarbonate daily.

In the cases reported above, the subjects have emptied their substitute bladders at intervals of 2-3 hours or longer and have taken ordinary diets with normal fluid intake. No sodium bicarbonate has been given. Moreover, it may be noted that in Cases 2 and 3 pyelography showed some interference with renal function, while in Case 5 there was poor outlining of the calyces on both sides with left hydronephrosis, a pre-operative blood urea of 62 mgm. per 100 mils, and a serum chloride level of 644 mgm. per 100 mils. Since the diversion of the urinary flow in these cases has been to the highest point in the large intestine and no attempt has been made to diminish possible re-absorption by frequent emptying, high fluid intake or diet, and since there is some evidence of lowered renal function in 3 of the 5 cases, it is surprising that hyperchloraemic acidosis has not so far been encountered.

This raised the question as to whether the preliminary irradiation of the colon, in addition to diminishing mucus secretion, may have reduced the capacity of the bowel to re-absorb electrolytes. An attempt has been made to secure further evidence on this point by a review of cases of uretero-sigmoid anastomosis performed in the Radio-Surgical Clinic at the Women's Hospital. These operations have been done either for palliation in advanced carcinoma of the uterus or in the treatment of post-operative uretero-vaginal fistulae.

Of 13 cases which survived for over three months, 8 had received during their treatment pelvic irradiation which had resulted, incidentally, in the sigmoid colon being subjected to a dosage considerably in excess of that applied to the ascending colon prior to the substitute bladder operations. Seven of these have been entirely free of the symptoms of nausea, vomiting, loss of appetite, abnormal taste in the mouth and excessive thirst, which are described as characterizing the re-absorption syndrome. Serum chloride levels have been within normal limits where estimations have been made, but in 2 cases no information on this point is available. The remaining case in this group has recently suffered attacks of vomiting, and has at times complained of thirst. She is going down-hill rapidly with extensive pelvic growth and increasing hydronephrosis. The blood urea has risen steadily to 165 mgm. per 100 mils and the serum chlorides are now 638 mgm. per 100 mils. It is difficult under such circumstances to estimate the role of re-absorption.

The non-irradiated group comprises 5 cases, two of whom suffered after operation from gross thirst and intermittent attacks of vomiting. They died with massive pelvic growth after five and six months respectively. Blood urea levels were within normal limits until shortly before death, but no estimations were made of serum chlorides. These cases will not be discussed further. One case has shown a steady rise in serum chlorides and a slight rise in blood urea. She has recently developed an unpleasant taste in the mouth and complains of thirst, but actually looks and feels well and can hardly be said to present a clinical problem, especially as the symptoms are not severe. The most recent estimation of serum chlorides shows a drop to normal levels, but her symptoms persist.

Of the remaining two cases in this group, one, after undergoing anterior exenteration and uretero-sigmoid anastomosis, suffered from intractable thirst, nausea, and loss of weight for six months after operation. Pelvic irradiation was then carried out because of a clinical diagnosis of residual pelvic growth. Following upon this, her symptoms disappeared and she has remained well for the past fourteen months. Serum chlorides are now within normal limits, but unfortunately no estimations were made prior to pelvic irradiation. The other case was operated on thirty-one months ago, bilateral uretero-sigmoid anastomosis being performed for post-operative uretero-vaginal fistulae. A certain amount of leakage of urine continued to occur because of a small recto-vaginal fistula due to an old obstetrical injury. Clinically she remained extremely well and serum chloride and blood urea levels were within normal limits, as were the pyelographic appearances. Four months ago she decided to undergo an operation for closure of the fistula and this proved successful. Since then she has developed an unpleasant taste in the mouth and complains of thirst

and lack of energy. Serum chlorides now show for the first time a slight rise, 638 mgm. per 100 mils.

It is unfortunate that in this retrospective review of cases of uretero-sigmoid anastomosis the biochemical evidence is too superficial and incomplete to be of much value, but the clinical evidence tends to support the idea suggested by the behaviour of patients in whom a substitute bladder has been made from irradiated bowel.

It should be pointed out that both irradiated and non-irradiated cases empty the bowel at intervals of three to four hours, and often longer. Some do not get up at night. None of them limit salt intake, force fluids, or take sodium bicarbonate.

Should it be found that irradiation of the bowel with moderate dosages can be used to control re-absorption of electrolytes when uretero-intestinal anastomosis is carried out, it may obviate the necessity of adopting a regime which patients must find somewhat harassing.

SUMMARY

1. Five cases of bladder substitution by the method described by Bricker and Gilchrist are reported.
2. It is considered that, either alone or in combination with pelvic exenteration, this operation in certain circumstances is a valuable palliative measure in the treatment of advanced cancer of the uterus.
3. The results indicate that continence is feasible.
4. Preliminary irradiation of the ascending colon has been found to result in a significant lowering of mucus secretion.
5. The absence of electrolyte disturbances would indicate that re-absorption of electrolytes is affected by irradiation of the bowel.
6. Thirteen cases of uretero-sigmoid anastomosis are reviewed and divided into those which had previously been subjected to pelvic irradiation and those in whom no irradiation had been carried out. There is evidence that re-absorption of electrolytes is lessened by prior pelvic irradiation.

APPENDIX

Radiotherapeutic technique (W. P. Holman).

As it was known that irradiation of the stomach with 1500 r. during three weeks produced cessation or marked diminution of acid and pepsin secretion for periods of six to nine months (Scott, Holman and Finckh [1953]), it was suggested that the mucus-secreting glands of the colon would be similarly altered and the secretion of mucus prevented or diminished for similar periods by similar dosage.

After localization of the ascending colon using a barium meal, this estimated dosage was delivered there through a single antero-posterior port using compression. The factors used were 250 K.V., H.V.L. = 2.8 c.u., F.S.D. = 51.5 cm. Typical port size 15 x 8 cm.

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Post-operative management has imposed a heavy burden on the Resident Medical and Nursing Staffs, and great credit is due to them.

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THE GEORGE ADLINGTON SYME ORATION

WORK AND LEISURE AND PLEASURE — AND LAW

By Sir John Latham,
Melbourne

WHEN I was asked to deliver the George Adlington Syme Oration before the Royal Australasian College of Surgeons, and, after much hesitation, accepted the invitation, I thought it unwise to attempt to speak upon the subject of surgery from either the doctor's or the patient's point of view. I thought of Sir George Syme as I knew him—a man who had won the highest reputation in a learned and skilled profession. His prestige was due to the quality of his work. The quality of his work resulted not merely from natural ability, but from devotion to work throughout his life. His success was not accidental or the easy product of some inborn faculty. It was based upon hard intelligent and industrious work. So I chose as the subject of this address—"Work and Leisure and Pleasure—and Law".

Except perhaps in some rare tropical islands where the cocoanuts fall from the trees and the bananas grow themselves, work is a necessity for the continuance of human existence. If work ceased, we would all die. For some fortunate people their work is sufficient pleasure, but nearly all require, or at least desire, some pleasure outside and beyond their work. The satisfaction of this need or desire demands some leisure—some freedom from work. The law has intervened to prevent overwork in the form of sweating, to enforce fair conditions of work for many workers, and to secure leisure so that they may enjoy life more abundantly.

The pursuit of pleasure as an end in itself is doomed to failure. In a broadcast last December Bertrand Russell said:

> "It is a commonplace among moralists that you cannot get happiness by pursuing it. If you look about you at the men and women whom you call happy you will see that they all have certain things in common. The most important of these things is an activity which at most times is enjoyable on its own account, and which, in addition, gradually builds up something which you are glad to see coming into existence."

Work has always been unpopular with most people, though they realize its necessity. It has been regarded as the curse of Adam—"In the sweat of thy face shalt thou eat bread". The Hebrew idea of heaven—developed by priests and prophets—was, as a young friend of mine once said, "In church all the time, singing hymns, with no work to do". Another authority, Jerome K. Jerome, had a somewhat similar point of view. He said: "I like work. It fascinates me. I can sit and look at it for hours. I love to keep it by me, the idea of getting rid of it really breaks my heart."

In the Middle Ages men dreamed of the Land of Cockayne where the larks flew right down into a man's mouth and roast geese walked the fields. In more recent days they sang of the Big Rock Candy Mountain "where they hung the Turk that invented work" and where there was a lake full of beer, and hens laid soft-boiled eggs. These were visions of Utopia.

The real world was very different. The sorrow and sadness of men who worked very hard for very small reward runs through William Langland's "Piers Plowman" and many other writings through the centuries. In the recent and present years of disillusionment, indecision and irresolution it has become the fashion among many intellectuals to treat with scorn the nineteenth century belief in the possibility of human progress as a result of using our reason and of thrift and hard work. The poets of self pity after the 1914-1918 war and T. S. Eliot, the author of "The Waste Land", with its picture of despair as the normal human lot, have been acclaimed. Men are going back to primitive forms of religion, to morbid introspection, to existentialism and to intuitive mysticism which holds its own by declining to submit

itself to criticism or cross-examination. Those who seek to convince their fellows of the necessity of hard intelligent work and of the possibility of finding joy in such work run the risk of being described as unintelligent extroverts.

Thus there are many things which tend to support the easily accepted view that work is a curse and the less of it the better. This attitude is well expressed in the words:

> "We go to work to earn the cash to buy the bread to get the strength to go to work to earn the cash to buy the bread", and so on.

So the value of work is reduced to the amount of money in the pay envelope.

There are, however, quite different views of work. The great apostle of work in England was Thomas Carlyle. He wrote:

> "Blessed is he that has found his work; let him ask no other blessedness."

In Ecclesiastes we read:

> "Whatsoever thy hand findeth to do do it with all thy might—for there is no work nor device nor knowledge nor wisdom in the grave whither thou goest."

This is the opposite of the cult of "good enough"—"that will do", which is one of the curses of Australia. Satisfaction with the second rate, with poor quality goods and poor quality service will never make a country great. The man who always does his best—and we still have many such—is an asset to his country. The man who just does enough to get away with it—and we have too many such men—is no credit to himself or to his country.

Whether work is regarded as an irksome duty, a wearisome task, a necessary burden, or a pleasing use of human faculties, depends upon the character of the worker and all the circumstances. To the same person, as we all know, some work will be depressing and other work will be a delight. Work which would be drudgery in some circumstances may become pure pleasure in other circumstances. The youth who wipes up the dishes which his girl washes may be having a grand time. Reginald L. Hine, in "The Confessions of an Uncommon Attorney," says:

> "It is a pity that there is something heavy and sad about that word 'work'. Work done for self is wearisome. 'Man goeth forth to his work and to his labour until the evening'. It is the curse laid upon the sons of Adam. But work done for others should bring joy and satisfaction."

The artist generally enjoys his work. He throws his soul into it and it is pure pleasure. A great violinist playing with a good symphony orchestra must reach the very height of human enjoyment in losing himself in his art, and many of the members of the orchestra will be equally elevated into happiness. A skilled surgeon finds real satisfaction in his work. It is the same in the case of many professional men. The skilled and self-respecting craftsman contemplates his work with pleasure. So also do many farmers and others engaged in rural industry who can see the results of the work of their hands. In all these cases there is a sense of accomplishment. There has been a natural use of human faculties for a desired end the achievement of which can be perceived and valued. These are the fortunate people.

But most people who work regard work as a means of procuring a livelihood, not as part of a satisfying life. For many millions work is only the means of struggling for a bare existence, or at best is the endurance of an unavoidable and dull task. In a wage-economy, in factory life, millions of people have to make a living by following an uninteresting routine—doing the same thing for year after year, and with nothing personal to show for it except the wages periodically paid. Such work is necessary and unavoidable. Men become accustomed to routine and, as long as they are not overworked, they do not, in general, complain of the nature of their work. But it may deaden the soul, and it will do so if there is nothing in a man's life except such work. The increasing urbanization of modern life, the aggregation of great numbers of people in great cities, together with the dullness of their work, often leaves little colour and vitality in life and is sometimes responsible, in the case of the more intelligent, for a feeling of frustration which is apt to manifest itself in anti-social directions. In a great city a man tends to become a de-personalized statistical unit in a class which is defined by reference to

economic characteristics. He is merely an employer—or an employee. A man wants to be a person, to have some assurance of personal dignity and worth, to be someone who matters. He has a better chance of being somebody away from a big city, where he may not know even the names of his neighbours. Away from the big city he may well have more friends and fewer mere acquaintances. Decentralization has many advantages in helping to form a balanced and integrated society.

One of the objectives of social policy should be to give a man an interest in his work and to help him to develop interests outside his work. Employers who have imagination can do a great deal to help when they take a human interest—not a patronising interest—in their employees, when they make them feel that they are human auxiliaries in an enterprise in the success of which they have a personal interest and concern—and are not merely cogs in a mechanical set-up. Willing work is much more pleasant and much more efficient than unwilling reluctant work performed without interest or in an atmosphere of hostility. Good management-labour relations are therefore economically, as well as socially, of great importance.

One of the obstacles to the establishment of such relations, and therefore of fully efficient and pleasant work, is due to the deliberate cultivation in some quarters of hostility to employers. There are political propagandists who teach that the boss is the enemy of the worker—so that the right thing to do is to take every opportunity to irritate and worry him—and (though this is not realized) that workers should try to make a failure of the business in which they are employed. Such tactics reduce or destroy the profits of an enterprise and make it impossible to pay the wages which could otherwise be paid.

What prospect is there for a worker who really believes that it is his duty to oppose and fight an employer whenever he has the opportunity? If he really believes in the dogma of class enmity between employer and employee, he can never honestly become either an employer or a manager for an employer. He must remain a rank and file employee all his life, whatever his ability may be. A few of such men may achieve a precarious union office, where they will generally have to fight to hold their place every one or two years, and they may get into Parliament. But the others, so long as they adhere to their principles, can never be leaders in industry itself. They will suffer from frustration and discontent and they and the community will lose the benefit which would have accrued if they had not suffered from an anti-employer complex.

Employers as a class are becoming more conscious of the importance, even from a purely economic point of view, of good relations with their employees. But some employers are mean and grasping and selfish. They are principally to blame for the hostility of so many workers towards employers in general.

The modern world is highly competitive. In Australia we do not sufficiently recognise this fact because, on the whole, we have been extremely fortunate. The world has paid us, and is paying us to-day, high prices for our products; recently we have had a run of good seasons and we have never had war in our own country. But we will need to use all the ability that we have and to work hard if we are to hold our own against less fortunate but hard-working and industrious peoples.

Nearly all men need some other interest than an interest in their work. I quote Bertrand Russell again:

> "We must learn not to become so obsessed by any one aspect of life as to forget the rest. We must not let work so monopolize our energies that we have nothing left for love and affection and careless play."

Leisure provides the opportunities for pleasure in the development and use of human faculties.

How do our citizens use their leisure? Some have active interests outside their work—in a church, a friendly society, a trade union, a political party, in sport of various kinds, and there is always, or almost always, a family interest. But a tremendous number have no interests outside themselves and their families. They perhaps go to the pictures, the races or the football, where they are merely spectators for a few hours. There is great need for more intelligent and pleasurable use of leisure. We should aim at a

higher standard of life—that is, of living. The standard of true living is not determined merely by the wages paid.

> "We live in deeds, not words; in thoughts,
> not breaths;
> In feelings, not in figures on a dial;
> We should count time by heart throbs.
> He most lives
> Who thinks most—feels the noblest—
> acts the best."
>
> (Bailey: Festus).

Consider a man in one of the highly paid but unskilled occupations. He works only forty hours a week and accordingly has a great deal of leisure. What does he do with it? If he lives in the city and has no garden, what can he do? Too many keep themselves poor by gambling on the horses and the dogs, or in lotteries. We offer them little else. The ordinary man ought to have more opportunities for using his leisure in such a way that he will add something to his life. The progress in the establishment of free libraries is encouraging, but there should be many more of them. There should be more opportunities for hearing live music—at low cost. Further steps should be taken to bring better class drama and our art galleries into the lives of the people. Something is being done by enthusiasts in this way, but, if the social importance of what they are doing were more fully recognised and they had further financial support, much more could be done. Education should not be supposed to end when a boy or a girl leaves school. The efforts of those who are working in adult education in these various fields should be generously supported. They all help to raise the real standard of living.

It should do us good to learn of the opinions of other people about us. We are, as a people, complacent and self-satisfied, and most of us resent criticism. (In this, however, we are really not exceptional.) We should, occasionally at least, condescend to see ourselves as others see us. Some of our critics are, I think, rather hard on us in relation to both our work and our manners, but we cannot ignore their general agreement that many of the men of Australia, not the women, are becoming, or have already become, very lazy. The Melbourne "Sun" this year (22nd January, 1953) published a number of recent comments upon general loafing (by men only) in Australia. An American writer, Dr. John Burchard, Dean of Humanities and Social Studies at the Massachusetts Institute of Technology, who was in Australia for several months, reported that he watched bricklayers laying 200 bricks a day, five days a week. He reported to America that some of these men laid between 700 and 800 a day over week-ends on private projects. The trouble is that ordinary work does not seem important to many of our men and that they think that loafing does no harm. Indeed, some of them entertain the infantile opinion that the more loafing there is, the more jobs there will be. Their motto is "The minimum work for the maximum pay." A people which adopts such a rule will sign its own death warrant. A good worker not only gets jobs himself, he helps to make jobs for others.

Another American visitor, James Michener, a well-known author, wrote recently, "Australians are a delightfully unruly people who shout for production and baulk at overtime." A Frenchman, the correspondent of the leading Paris newspaper, "Figaro", reported:

> "The entire population is enslaved by a force as mysterious and implacable as an Indian divinity — leisure. A maximum of leisure has been gained for a maximum of discomfort and boredom."

A Spanish writer of world celebrity, Dr. Salvador de Madariaga, liked our people, but said:

> "The cordial, simple human approach of the Australian cools off at the slightest suggestion of anything impinging on his leisure."

An Australian woman said to me recently:

> "I saw a number of men doing some excavation. They were working like mad, with real enthusiasm. I had seen nothing like it for years. Then I saw that they were 'New Australians'."

There is much criticism of our manners from visitors. This, I think, is largely due to the fact that they have the misfortune to see a good deal of some of our hotels. Australians as a whole are not discourteous or disorderly or inconsiderate. There is, in general, a high standard of behaviour in public assemblies (except at some election meetings and football matches) and in public conveyances and in the streets, but there is an uncouth minority who do their country a

great deal of injury. The hooligans who disfigure our cities by scrawling or painting what they call slogans on walls and bridges that do not belong to them, are in this class. The least pleasing of this type are those who assert their personality by rudeness, and they are often distinguished by their ignorance as well as by their truculence, especially when there are several of them together. All of us in Australia are either migrants or the descendants of migrants, but this minority is apparently not aware of this fact. They think that they show that they are good Australians by being offensive to recent arrivals who look different or speak differently. Behind this attitude is an idea which is only gradually disappearing from the minds of many Australians—that immigrants will take the bread out of the mouths of our own people and will take their jobs away from them. Most people have now realised that we must populate our country or perish, and that, on any long-term view, an increase in population means an increase in the number of jobs available. But the minority to which I refer does not know this and it thinks that it is protecting itself by making life uncomfortable and even intolerable for recent immigrants. I cite a very recent example (July, 1953). It is reported from Adelaide that after more than two years in Australia 45 British families are returning from South Australia to England. They came out as migrants. They declared that the people in Australia "are most unfriendly toward us". They said that they were fed up with Australia and everything Australian. They said that they would do everything in their power to prevent other families in Britain coming to Australia under the migrant scheme. Such happenings—and this is by no means an isolated instance—injure the reputation of Australia in the eyes of the world at large. They are reported in the press of other countries—countries with which it should be our object to establish and maintain friendly relations. It is not in accordance with our ideas to attempt to suppress this minority—we can only try to set them a better example and to educate their children.

Now I come more specifically to the relation of these considerations to the subject of the attitude of people to work. The minority to which I have referred acts upon the view that the amount of work available by doing which a man may earn a living is a static and constant quantity which is to be divided between the workers, with the result that the more workers there are the fewer jobs there will be. Such a national outlook would be one of stagnation and of despair as to our future. The amount of work necessary and available in a country such as Australia is an expanding quantity. There is an enormous amount of work to be done in Australia in developing the country, in providing for the needs of the people, and in producing goods to be sold overseas so that we may maintain and improve our standard of living.

I commend to you what was recently said by Mr. Tom O'Brien, M.P., Chairman of the United Kingdom Trades Union Congress:

> "There are too many people in industry today living in the shell of their own cosy illusions. There are employers who will not be enterprising and who are content to stay in the same old ruts. There are workers who think of efficiency as having something to do with the boss but nothing to do with themselves. I say to all of them that if they persist in such attitudes for long then all they will have to live on will be their own illusions. Whether industry is publicly or privately controlled or owned, it is everybody's job to help the nation to earn its living."
>
> "Today it is reactionary to talk of working oneself out of a job. If people talk like that and act on that basis they will be out of a job all right, because Britain will be out of a market. Unless we can produce more goods more cheaply we can say goodbye to full employment, social security, and the living standard that we have. It is as simple and as dangerous as that. A standard of living has got to be earned."

We have a 40 hour week. A reduction of working hours was not claimed upon the ground that men generally were overworked. The claim was based upon the contention that the community was prosperous, that we could afford to give the workers more leisure, that they were therefore entitled to it, and that production would be increased, not diminished, if the claim were granted by the Arbitration Court. It is not surprising that employees who saw their boss regularly going off for a long golf weekend should think that they also could rightly claim to do a little less work for the same pay.

In the United States of America there is a 40-hour week, but production has increased greatly because men work hard. I take from a recent article in Harper's Magazine the following statements by Frederick Lewis Allen, Editor in Chief, and the writer of several books with very large circulations:—

"In 50 years the amount of goods consumed per person in America has gone up 250 per cent., while the average work week has dropped from 60 hours to 40.

"In the 50-year period, during which the labor force has more than doubled, the number of unskilled workers has dropped from 11,000,000 to less than 6,000,000. At the same time, the number of engineers and technicians has shot up from 40,000 to 400,000.

"In 50 years of American progress, during which unions have grown in membership from about 800,000 to over 15,000,000, they have served as a major force in funneling an increasing share of the national income into the hands of the workers."

Mr. Allen finds evidence of a significant change in the trend of United States' industrial relations from labor-management conflict into labor-management co-operation. One of the results has been that:—

"In the last two decades millions of Americans have moved up into the middle-income group — ranging from $3,000 to $10,000 per year. The largest addition to this group, to which more than 50 per cent. of all Americans now belong, has come from the ranks of the industrial workers."

Thus in the United States there has been a widespread change from conflict to co-operation, with an increase in general welfare. There is surely here a lesson for Australia.

In 1914 Henry Ford raised the minimum wage of his employees from 2 dollars a day to 5 dollars a day. I recognize that such a gesture cannot be repeated, but I wish to call attention to the principles upon which his action was based. He wrote:—

"The real progress of our company dates from the time we raised the minimum wage to $5, for then we increased the buying power of our own people, and they increased the buying power of other people, and so on. Behind the prosperity of America is the enlargement of buying power by paying high wages and selling at low prices."

He defined "proper wage" and "price" in the following words:—

"The right price is not what the traffic will bear, and the right wage is not the lowest sum a man will work for. The right price is the lowest an article can steadily be sold for. The right wage is the highest an employer can steadily pay."

This is a practical programme if it is accepted by both sides, employees as well as employers striving in a co-operative spirit to make their joint work at once a success as a commercial enterprise and a success in relation to human relations in a civilised society.

After I had prepared this address I read a leading article published in the London "Times" just after the Coronation. The problems to which I have referred evidently exist in England as well as in Australia. I quote the following extracts from this article:—

"Almost any questioning of the present state of affairs is likely to be construed as an attack on the workers' standard of living. It is not. It is an attack on an all too often accepted standard of working. The evil should not be exaggerated. In many parts of the national effort strenuous work is being done. Nor must the criticism be narrowed. The non-doers and half-doers are to be found in all grades and classes. . . . Yet such is the mind of the nation and the state of politics that neither Government nor Opposition dare allow themselves to be disclosed fully facing the facts. A country made great by resourcefulness and energy is in many places slowly strangling itself with restrictive practices, by a placing of convenience and comfort before efficiency and productivity, by a plain disinclination for hard work."

The real truth which we all need to learn and to apply is that the maintenance of a high standard of living depends upon a high standard of working.

The standard of working in Australia has been lowered and depreciated by the current high taxation. The effect has been the same in all grades of occupations. Men deliberately work less and earn less because if they work

more and earn more so large a part of the additional earnings is subtracted in taxation that they say it is not worth while. It is notorious that this is the case with many manual workers. The position is much the same with many professional men. A busy suburban doctor told me that he attended to night calls with the greatest reluctance, because his fee, reduced by taxation, hardly paid for the petrol which he would use if he went to see the patient. The high rates of taxation are helping to depress the energy of our people.

The Australian people have been anxious and generous in providing fair wages and good working conditions for certain classes of workers. The whole system of industrial regulation—a dominant federal system and six concurrent differing State systems—needs, in my opinion, fundamental reconsideration. But that is too large a subject for this occasion. There are many Federal and State industrial tribunals which make legally binding awards. The manual workers are the principal beneficiaries. The wages of many wharf labourers are higher than the salaries of many university lecturers and other university graduates. A community simply cannot afford the indefinite continuance of such a state of affairs. In many industries the provisions of awards are almost incredibly detailed. This degree of legal control is not found to be necessary elsewhere. In other countries the parties to industry are much more free to make their own arrangements. Collective bargaining between employers and employees without legal proceedings and accompaniments might, I suggest, be encouraged, at least as an experiment. Wages in Australia are now fixed by reference to what is called the cost of living. The "C" series of retail prices is used, not as representing any actual cost of living, but as a guide to variations in the cost of living. Thus wages are fixed by reference to the consumption of goods and services by the wage earner, not to his production. The prosperity of the community has made it possible to continue this system, but the principle that consumption is to be maintained at a particular level, whatever the cost, cannot itself be maintained indefinitely, unless we have already entered into the millenium. Wages, like profits, come out of the proceeds of industry. They must, in the long run, if industry is to continue, bear a relation to the volume and value of the production of goods and services.

No one is really satisfied with the present system. Increases in wages bring little benefit even to the recipients, because they put up prices, and the non-recipients, who have fixed and not adjustable incomes, are all suffering. Costs of production have increased and complaints are made that we are losing trade because we have priced ourselves out of the otherwise available markets. The basic wage has become so high that it is a general view that the proportionate margin between the basic wage and the wages of skilled workers cannot be maintained. Today, we are told by those who know, there are practically no workers on the basic wage. They have all succeeded in convincing some tribunal that they have some skill which should be specially rewarded. Thus the most ordinary occupations, in which any able bodied man could become competent in a week, have been given "margins for skill". The really skilled worker—the man who has served an apprenticeship or otherwise has been through a real course of necessary training and experience—is much more important to the success of our industry than the unskilled multitude. But that multitude has a lot of votes. The pretence that commonplace occupations are skilled should be abandoned. Then real margins for real skill could easily enough be provided. We should give every encouragement to skill. We should aim not at the fostering of the average and the mediocre, but, while protecting them against anything unfair, should give every opportunity for advancement to the skilled man who sets for himself a standard of excellence.

I repeat that the whole subject of industrial regulation requires reconsideration. One step that could be taken with great advantage would be the establishment of an Economic and Financial Bureau which would provide reliable statements of fact upon the basis of which policy could be determined. But it would be worse than useless to set up such a Bureau unless a high grade staff could be secured.

I have spoken of work, of leisure, of pleasure, and of law in its relation to work. I have, I hope, shown that the attitude of men to their work profoundly affects the interests, not only of themselves, but also of the community as a whole, and that there must be

hard and intelligent work if we are to keep our country for ourselves and for our descendants. I have also tried to show that a proper attitude to work and a realisation of the possibilities of leisure will add greatly to the pleasures of life. Finally, I have urged that more co-operation, and possibly less law, between employers and their workers, would contribute greatly to the benefit of all.

We live in a democracy. The people, through their representatives, rule themselves. If the people of a country are selfish, divided and unintelligent, their democracy will not be a success and may fail disastrously. The civilised world may, many fear, be overwhelmed in some atomic catastrophe. But if this does not happen, our future depends in large measure upon the way in which we work, the wise use of our leisure, the character of our pleasures, and the laws which we make for ourselves — in general, upon the degree to which we succeed in developing a true sense of social responsibility.

RADICAL DISSECTION OF THE NECK

By Howard H. Eddey

Royal Melbourne Hospital, Melbourne

THE outlook for a patient suffering from malignancy of the face or oral cavity depends upon adequate control of the primary growth, the performance of a satisfactory neck dissection when indicated and the frequency with which distant metastases develop.

The incidence of distant metastases among patients dying with head and neck cancers was stated by Crile (1906) to be 1 per cent., and as late as 1944 Brown and McDowell reported that cancer of the mouth and lips rarely metastasized below the clavicle even terminally. It is now recognized that the incidence of distant metastases is much higher and in a group of 200 autopsies performed by Peltier *et alii* (1951) on patients with cancers of the head and neck, 34 (17 per cent.) were found to have distant metastases. This is in agreement with an incidence of 20 per cent. stated by Braund and Martin (1941).

Even with this incidence of distant metastases, good results should be obtained from treatment of cancer of the face and oral cavity. That this is not always so is due partly to inadequate treatment of the primary growth and partly to inadequate neck dissection for cervical metastases.

The primary growth may be treated by radiotherapy or by surgery or by a combination of both. Dissection of the neck, when indicated, may follow when the primary growth is adequately controlled or be combined with surgical excision of the growth or what remains of it after preliminary radiotherapy.

It is not the purpose of this paper to discuss the treatment of the primary growth or the indication for the operation of radical neck dissection but to describe the technique of this operation. Experience in radical neck dissection in this country is limited and the operation may be performed inadequately unless certain principles are understood. The writer's experience of this operation has been obtained in the performance of 35 radical neck dissections in 29 patients.

Historical Note

G. Crile described the technique of radical neck dissection in 1906 by which time he had performed the operation on 36 occasions. More frequently (96 operations) he performed a less radical dissection. Bartlett and Callender described a similar operative technique in 1928. Recently radical neck dissection has been combined with excision of the primary growth in continuity including, if it be involved, portion of the mandible.

Carroll (1952) and Morfit (1952) both describe the technique of *en bloc* excision of intra-oral carcinoma and the cervical lymph nodes and it is in this direction that advance in cancer therapy of the head and neck will be made.

Case Material

Thirty-five radical neck dissections have been carried out in 29 patients. Of these, 30 operations were performed on 24 patients who had epithelioma of the face or oral cavity and 5 operations were performed on 5 patients who had malignant melanoma of the face or upper neck. In these latter 5 patients, one operation was a therapeutic neck dissection and four were prophylatic dissections although in one of these the lymph nodes contained metastatic growth on microscopical examination.

The six bilateral operations were staged at an interval of three to four weeks. A portion of the horizontal process of the mandible was removed in 2 patients who had epithelioma of the oral cavity because of attachment to bone of an involved submandibular lymph node.

21 patients were males and 8 were females, the average age being 57 years (32 years to 76 years). In all cases of epithelioma, the primary growth had been treated by radiotherapy.

Since all operations have been performed over the past 5 years and the series is small, no useful purpose is served by detailing the results to date. However the following brief survey of patients suffering from epithelioma of the face or oral cavity indicates the general trend of this disease in this series. This is in agreement with the published results which may be tabulated as follows:—

1. The operative mortality of radical neck dissection is low.

2. The cure rate of epithelioma of the face and oral cavity with cervical metastases is comparatively low.

3. The incidence of distant metastases following cervical metastases is not inconsiderable.

4. Uncontrolled local recurrence of epithelioma of the oral cavity may result in death of the patient in the absence of any cervical or distant metastases.

5. Cervical recurrence may occur following the most radical neck dissection particularly if the epithelioma involves the floor of the mouth.

6. The diagnosis of metastatic involvement of the cervical lymph nodes on clinical examination is proved to be incorrect on microscopical examination in 10-20 per cent. of cases.

The site of the primary epithelioma in 24 patients is detailed in Table 1.

Twenty-seven operations in 21 patients with epithelioma were therapeutic dissections and 3 operations in 3 patients were prophylactic dissections indicated for active growth in the posterior part of the oral cavity. In the 27 therapeutic dissections, the clinical diagnosis of cervical metastases was proven to be correct on 21 occasions.

TABLE 1

SITE OF PRIMARY EPITHELIOMA

Tongue	5
Lower lip	5
Mucosa of the cheek	4
Floor of the mouth	4
Palate	2
Upper lip	1
Skin of the face	3

The results of treatment to date are summarized in Table 2 and Table 3.

TABLE 2

EPITHELIOMA OF THE FACE OR ORAL CAVITY

24 PATIENTS

	Patients	Alive	Dead
Cervical lymph nodes, positive	17	11	6
Cervical lymph nodes, negative	7	5	2

TABLE 3

CAUSE OF DEATH — 8 PATIENTS

Cervical lymph nodes, negative	Cervical lymph nodes, positive
Distant Metastases .. .. 3 Primary growth—Lip 2 Skin 1	*Local recurrence* .. .. 2 Primary growth—Oral Cavity 2
Neck recurrence Primary growth—Floor of mouth 2	
Post-operative .. .. 1 Primary growth—Lip	

From these tables it will be seen that of 6 cases with epithelioma of the lip, 3 are already dead, of 15 cases with epithelioma of the oral cavity, 4 are dead and of 3 cases of epithelioma of the skin of the face, 1 is dead.

THE TECHNIQUE OF RADICAL NECK DISSECTION

The dissection is an extensive one. All lymph nodes are removed from the horizontal portion of the mandible and the mastoid-mandibular fossa above to the clavicle below and from the mid-line of the neck anteriorly to the anterior border of the trapezius muscle postero-laterally. The lymph nodes are removed in a block of tissue which contains the sternomastoid and digastric muscles, the internal and external jugular veins, the submandibular salivary gland, the lower pole of the parotid salivary gland and the accessory and superficial cervical nerves.

Endotracheal anaesthesia is essential so that the head and face may be covered with drapes to allow the surgeon mobility in operating. A tracheotomy is necessary if the radical neck dissection is combined with an extensive intraoral procedure. A sandbag is placed beneath the patient's shoulders to throw the neck forward and extend the head (Fig. I). Arrangements must be made for a blood transfusion to be given at any stage of the operation if found necessary.

The most difficult portion of the dissection is clearing the fossa between the mastoid process and the ramus of the mandible and this dissection is easiest if done last. In general the dissection proceeds from the root of the neck upwards but the preliminary clearing of the digastric triangle renders the final dissection at the base of the skull easier.

The operation is divided into five stages.

1. The incision and reflection of the skin flaps.
2. The dissection of the digastric triangle.
3. The division of the sternomastoid muscle and internal jugular vein at the root of the neck.
4. The dissection of the posterior and carotid triangles.
5. The dissection of the mastoid-mandibular fossa.

All dissection is performed with a sharp scalpel, thus enabling small veins to be clamped before they are cut; gauze stripping of tissues is to be condemned as this results in haemorrhagic untidy surgery.

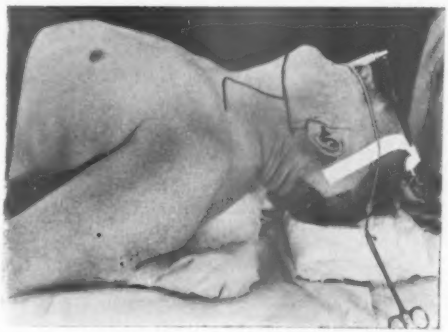

FIG. I. Photograph of a patient showing:—
1. the incision,
2. the posture of the patient on the operating table, and
3. the endotracheal tube in place.

Stage 1. The Incision and Reflection of the Skin Flaps

The incision (Fig. I) begins just below and to the opposite side of the point of the chin and curves posteriorly $\frac{1}{2}$ inch below the angle of the mandible to end behind the tip of the mastoid process. From this incision a second incision extends along the anterior border of the sternomastoid muscle from the angle of the mandible to the clavicle and is then carried backwards for 2 inches just above the clavicle. The upper skin flap is then reflected to expose the horizontal process of the mandible, the lower pole of the parotid salivary gland and the lower half of the mastoid process.

The anterior and posterior skin flaps are turned back to expose the whole of the neck from the midline to the anterior border of the trapezius muscle down to the clavicle (Fig. II). Whether the platysma muscle is reflected with the skin or not does not influence the completeness of the dissection or the healing of the wound. However, if the skin only is reflected, dissection of the submandibular region is rendered easier in that the platysma muscle provides a firm structure to grasp in clearing the submandibular lymph and salivary glands.

The skin reflection is accompanied by brisk haemorrhage which is best controlled by the use of diathermy.

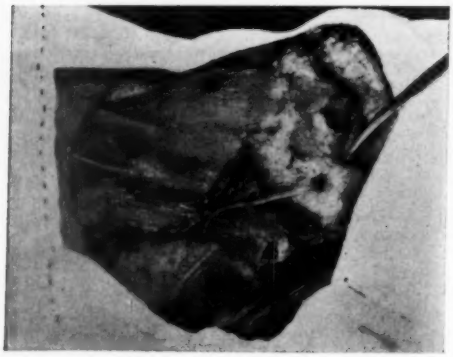

FIG. II. Photograph of the operation after mobilization of the skin flaps showing:—

1. the angle of the mandible indicated by a dissector, and
2. the great auricular nerve passing forwards and upwards across the sternomastoid muscle.

Stage 2. Dissection of the Digastric Triangle

In this (or in the last) phase of the dissection the marginal mandibular branch of the facial nerve will be divided unless it is identified and mobilized. Whilst weakness of the lower part of the face is a small price to pay for cure of cancer, there are many cases in which it is possible to preserve this branch of the facial nerve. This applies particularly to radical dissection for cancer of the lip or anterior part of the oral cavity in which only the lower pole of the parotid salivary gland will be removed. When the nerve is to be preserved it is exposed below and behind the angle of the mandible deep to the platysma muscle and superficial to the deep fascia. It is identified by incising the platysma below the angle of the mandible and turning the muscle upwards. The nerve is mobilized backwards to the parotid salivary gland and forwards to the facial vessels and retracted upwards (Fig. III).

The platysma and deep fascia are divided from the facial vessels forward along the lower border of the mandible to the symphysis menti and then downwards to the upper border of the thyroid cartilage. The platysma and deep fascia are reflected posteriorly from the symphysis and the origin of the anterior belly of the digastric muscle is detached from the mandible (Fig. III). These tissues are then dissected posteriorly off the mylohyoid muscle and the posterior border of this muscle identified. The facial vessels are divided as they cross the mandible in front of the masseter muscle. The posterior border of the mylohyoid muscle is retracted forwards and the submandibular duct and

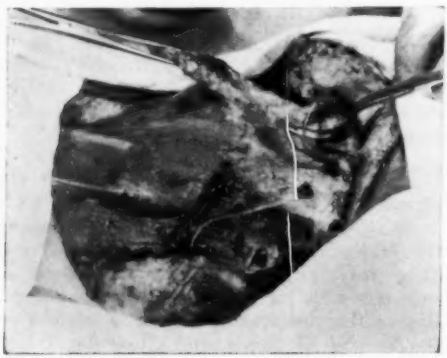

FIG. III. Photograph of the operation showing:—

1. A dissector under the marginal mandibular branch of the facial nerve,
2. the facial vessels crossing the mandible, and
3. the reflection of tissues from the symphysis menti.

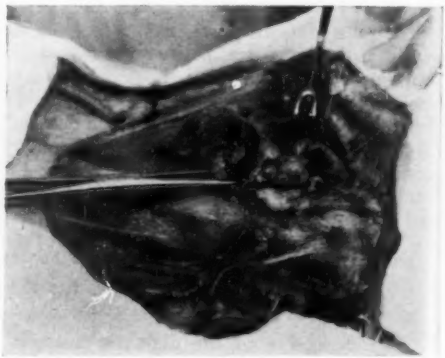

FIG. IV. Photograph of the operation after completion of the dissection of the digastric triangle showing:—

1. the posterior border of the mylohyoid muscle retracted forwards,
2. the lingual nerve held by a silk ligature with the hypoglossal nerve below, and
3. the facial artery entering the posterior pole of the submandibular salivary gland above the posterior belly of the digastric muscle.

lingual nerve identified. These are bound together by connections between the nerve, the submandibular ganglion and the duct. These connections are divided and the lingual nerve retracted upwards (Fig. IV). A vein usually accompanies the submandibular duct and if this vein is torn, attempts to control the troublesome bleeding may result in damage to the lingual nerve.

The hypoglossal nerve lies $\frac{3}{4}$ inch below the duct on the hyoglossus muscle but it is not disturbed when mobilizing the duct and is in no danger of injury. After division of the submandibular duct, the mass of tissue now mobilized is turned a little further posteriorly to expose the facial artery where it enters the submandibular gland above the posterior belly of the digastric muscle and the artery is divided (Fig. IV).

Stage 3. Division of the Sternomastoid Muscle and the Internal Jugular Vein at the Root of the Neck

The incision in the deep fascia and platysma muscle is continued down the mid-line of the neck to the clavicle and the anterior belly of the omohyoid muscle is divided just below the hyoid bone. The deep fascia is divided just above the clavicle as far posteriorly as the trapezius muscle and this incision divides some supraclavicular nerves. The sterno-mastoid muscle is divided at its attachment to the sternum and clavicle.

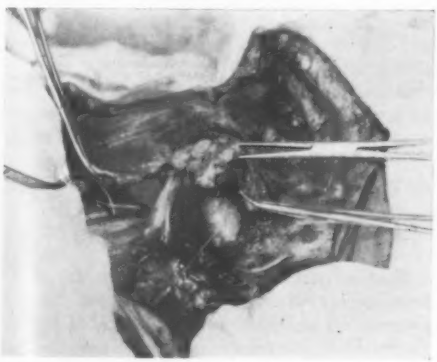

FIG V. Photograph of the operation after division of the structures at the root of the neck showing:—

1. the left jugular lymph trunk held by an artery forceps,
2. the phrenic nerve indicated by a dissector, and
3. the accessory nerve held by a silk ligature at the point where the nerve passes beneath the trapezius muscle.

The mass of tissue being turned upwards includes the internal jugular vein and the sternomastoid muscle.

The deep fascia and the sternomastoid muscle are turned upwards a short distance to expose the carotid sheath. The sheath is incised, the vagus nerve and common carotid artery identified and retracted and the internal jugular vein divided (Fig. V). If any sucking of air is heard or if air bubbles are seen tracking up beneath the anterior scalene muscle-sheath, the carotid sheath must be sutured over the stump of the vein to prevent air being drawn into the mediastinum since, if a large amount of air enters, severe cardio-respiratory embarrassment results in the early post-operative period. This complication only occurs if respiratory obstruction, due to imperfect anaesthesia, is present.

The fat, which is generally plentiful at the root of the neck, is divided from the carotid sheath to the trapezius muscle to expose the transverse cervical artery and vein, the posterior belly of the omohyoid muscle and the brachial plexus. The artery and vein are divided close to their origin from the thyreo-cervical trunk and the posterior belly of the omohyoid muscle is divided behind the clavicle.

On the left side of the neck, division of the fat lateral to the carotid sheath may result in injury to the thoracic duct, since the duct is difficult to identify in a fasting subject. Damage results in clear fluid collecting at the root of the neck and if the duct cannot be identified and ligated the only method of control is by mass ligature. The phrenic nerve is seen passing downwards and inwards over the scalenus anterior muscle protected by a fascial layer (Fig. V).

Stage 4. Dissection of the Carotid and Posterior Triangles

The structures which have been divided at the root of the neck are turned upwards and cleared from the underlying scalenus medius and levator scapulae muscles. The accessory nerve is divided as it passes beneath the anterior border of the trapezius muscle (Fig. V). Excision of the cervical portion of this nerve results in some disability in shoulder movement but ensures

completeness of the dissection. The cutaneous nerves of the neck are divided as they emerge beneath the lateral border of the scalenus anterior muscle.

FIG. VI. Photograph of the operation after dissection of the posterior and carotid triangles showing:—

1. the common carotid artery and the commencement of the external and internal carotid arteries,
2. the muscles of the posterior triangle, and
3. the digastric triangle.

The dissection proceeds easily up to the level of the posterior belly of the digastric muscle, several tributaries of the internal jugular vein being ligated (Fig. VI). The posterior belly of the digastric muscle is reflected and this exposes the internal and external carotid arteries. The hypoglossal nerve is seen to cross these vessels and turn forward on to the hyoglossus muscle. Division of the sternomastoid branch of the occipital artery allows the nerve to be mobilized forwards and upwards.

Stage 5. Dissection of the Mastoid-Mandibular Fossa

Reflection of the posterior belly of the digastric muscle enables the internal jugular vein, the accessory nerve and the cervical lymph nodes to be dissected from the levator scapulae muscle almost to the base of the skull.

The internal jugular vein and the accessory nerve are divided as high in the neck as possible and the vein ligated securely. The only structures now remaining to be divided are the lower pole of the parotid salivary gland containing the posterior facial vein, the digastric muscle and the sternomastoid muscle.

In many cases only the lower pole of the parotid salivary gland is removed with preservation of the facial nerve. When the primary malignancy occurs in the posterior and upper part of the oral cavity, it may be necessary to remove most of the parotid salivary gland in order to excise the parotid lymph nodes. If this be done then the cervicofacial division of the facial nerve will be divided. Removal of the mastoid process provides ready access at this stage of the operation. Troublesome haemorrhage generally occurs from the divided parotid salivary gland.

The dissection completed (Fig. VII), the wound is closed with drainage from the lower end.

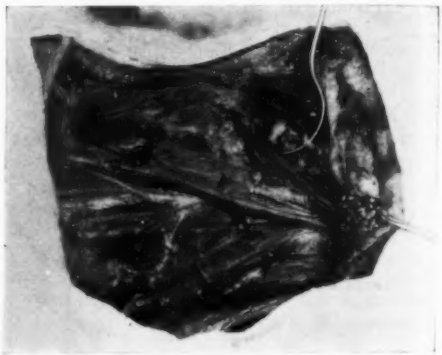

FIG. VII. Photograph of the operation after dissection of the mastoid-mandibular fossa showing:—

1. the lingual nerve indicated by a dissector with the hypoglossal nerve a short distance below,
2. the carotid arteries, and
3. the cut surface of the parotid salivary gland.

BILATERAL RADICAL DISSECTION

Radical dissection of the neck is an extensive operation and should not be performed on both sides of the neck at the one time. The procedure is the same on both sides of the neck with the possible exception of the excision of the second internal jugular vein.

It is possible to remove the internal and external jugular veins of both sides of the neck since it is probable that the vertebral venous plexus is sufficient to provide for the entire drainage of blood from the cranial

cavity (Gius and Grier, 1950). These authors report seven cases of staged bilateral radical dissection with removal of the internal and external jugular veins of both sides of the neck. In all seven cases varying degrees of oedema of the face was observed. This oedema gradually receded during the immediate post-operative period but some permanent puffiness of the face persisted in most cases. This was of sufficient degree in one case to be termed by the patient himself "fat face". Facial discolouration from a pink to a cyanotic hue was common immediately following the second operation but regressed more rapidly than the oedema. Severe headache persisted for several days.

Modlin (1950) reported six cases of staged bilateral radical neck dissection with at least four weeks' interval between operations. He noticed alarming immediate post-operative oedema of the face, conjunctive and laryngo-pharynx so that in all cases he now leaves one internal jugular vein but removes its sheath.

The operative death in this present series is regarded as being due to deficient venous return from the head and neck. The internal jugular vein was left intact in the second stage, the opposite vein having been removed in the radical dissection four weeks previously. At the end of the second operation the patient showed considerable oedema of the face and eyelids with some cyanosis. He died two hours later and autopsy examination revealed marked swelling and bruising of the inlet of the larynx, marked oedema of the face and considerable blood clot in the neck. The cause of death was reported by the pathologist (Bowden, 1949) to be due to asphyxiation from bruising and swelling of the inlet of the larynx resulting from use of the endotracheal anaesthetic tube. However, it appears more likely that a ligature slipped and considerable bleeding occurred under the skin flaps with compression of the remaining internal jugular vein. This resulted in deficient venous return from the head and neck with cyanosis and oedema of the face and larynx and gross respiratory obstruction. Immediate evacuation of the blood clot and perhaps a tracheotomy would almost certainly have saved this patient's life.

Therefore, whilst it is possible to remove the internal and external jugular veins of both sides of the neck by staged operations, this procedure is not without some risk to the patient and permanent oedema of the face is likely to follow. When the internal jugular vein is left on one side of the neck care must be taken to remove its sheath to ensure completeness of the dissection.

COMPLICATIONS OF RADICAL NECK DISSECTION

In most cases a greater or lesser amount of blood-stained serum collects under the skin flaps and this requires evacuation on one or more occasions. Dependent wound drainage with glove rubber for five to six days and firm wound dressing hastens adherence of the skin flaps to the underlying tissues. The serum collection may become infected and then pus will drain from the lower end of the wound for several days. The incision normally heals rapidly without gangrene of the anterior or posterior skin flaps.

Paralysis of the lower face results if the marginal mandibular branch of the facial nerve is divided but this can be avoided by mobilizing this nerve early in the dissection.

The thoracic duct may be damaged in dissections on the left side of the neck but this should be recognised at the time and the duct ligated, a procedure which produces no disability. If the duct is damaged and not ligated, chyle will collect under the skin in the lower part of the wound and will need to be aspirated frequently. Firm pressure dressings over the supra-clavicular region continuously for a few weeks will result in cessation of chyle leakage.

Although portion of the parotid salivary gland is removed, salivary fistula does not occur.

Rarely chylothorax or pneumomediastinum and pneumothorax may occur. Chylothorax results from unrecognised damage to the thoracic duct; chyle leaks into the mediastinum and, when sufficient pressure is built up, ruptures into one or both pleural cavities (Frazeel *et alii*, 1951). Pneumomediastinum and pneumothorax is due to air entering through the carotid sheath; its occurrence must be recognized at operation and prevented by closure of the sheath (Aitken and Smith, 1953).

DISABILITY FOLLOWING RADICAL NECK DISSECTION

The disability following this operation is not great and the scar soon becomes supple. Despite the removal of the sternomastoid muscle, the appearance of the neck is quite good although the wasting of the trapezius muscle is obvious at the base of the neck (Fig. VIII).

FIG. VIII. Photograph of a patient taken two years after radical dissection of the left side of the neck. The loss of the sternomastoid muscle and the wasting of the trapezius muscle can be seen.

Lower facial weakness will occur if the marginal mandibular branch of the facial nerve is divided. Anaesthesia over the postero-inferior portion of the cheek and over the lower third of the external ear results from division of the great auricular nerve. The side of the neck is flattened from loss of the sternomastoid muscle but there is no limitation in neck movement.

Paralysis of the trapezius muscle leads to imperfect co-ordination of abduction movement of the arm and inability to raise the arm completely to the vertical position (Fig. IX). There is also slight winging of the scapula. Patients accommodate themselves readily to this disability and obtain almost normal use of the arm.

FIG. IX. Photograph of the same patient as in FIG. VIII showing the good range of abduction movement of the left arm. The mild winging of the left scapula and the flattening of the base of the neck on the left side can be seen.

SUMMARY

1. The technique of radical neck dissection is described.
2. A brief survey has been made of 29 patients on whom this operation has been performed on one or both sides of the neck.
3. The complications which may follow the operation are described. The disability after operation is negligible.

ACKNOWLEDGEMENT

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CHRONIC ULCERATIVE COLITIS

A METHOD OF ILEO-RECTAL ANASTOMOSIS

By E. E. Dunlop

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FEW surgeons to-day offer surgical aid to sufferers from chronic ulcerative colitis without stressing the necessity for the patient to accept a permanent ileostomy as the price which must be paid for life and restoration of health.

There has been a hardening of opinion in favour of resecting both colon and rectum, and there is an increasing tendency to perform ileostomy and colectomy in a single stage as recommended by Miller, Gardiner and Ripstein (1949). Along with many others, the writer has stressed the importance of accepting the ileostomy life as a solution to the more severe forms of this distressing disease, and it has been found that this state has been supported cheerfully and is compatible with a happy and useful existence (Dunlop 1949).

Nevertheless, there is a small group of patients who are utterly unwilling to submit to an operative programme in which from the first the ileostomy artificial anus is regarded as inevitable, and irrevocable.

Further there are patients in whom the rectum shows little or no evidence of involvement by the disease, and circumstances may encourage some more conservative approach.

Methods of colectomy with conservation of the anal sphincter have been advocated by Devine (Devine and Devine 1948) and Ravitch (1948).

In the opinion of the writer, and others such as Gabriel (1952), the Devine operation which involves anastomosis by crushing a spur, leaves a recto-colic segment which may be associated with the continuation of serious symptoms, or relapse. The method of Ravitch, as pointed out by Goligher (1951) does not, in most hands, provide the exacting continence necessary for ileal content.

It is considered that the retention of about one-third of the rectum provides satisfactory continence, and that a low ileo-rectal anastomosis can be carried out safely even in the presence of some rectal involvement provided that the lower segment of bowel is defunctioned by a proximal ileostomy.

This proximal ileostomy has the additional virtue that time is given for the ileum to take over storage function, and for the ileal content to thicken before alimentary continuity is restored.

Further, the rectal stump may show considerable improvement during the period of rest.

Psychological Factors in Surgical Management

In common with most other surgeons, the writer only advises surgery in diffuse forms of chronic ulcerative colitis, when life has become threatened by grave complications or activity restricted seriously by chronic invalidism.

It is explained to the patient that a well constructed and well managed ileostomy is compatible with good health and the enjoyment of an active life, and it is stressed that ileostomy combined with excision of the diseased bowel offers the only certain cure of the disease.

Patients who present themselves for consideration of surgery are frequently in such a deplorable condition that any hope of relief is welcome. For the most part, it has been found that the ileostomy life has been accepted with grateful fortitude and that the patients have shown considerable resource in contributing individual ideas to minor problems of management.

In general, the bad results of ileostomy are the results of bad ileostomy technique, and this procedure brings much better results in the hands of surgeons experienced in this method of treatment.

Nevertheless, it cannot be denied that ileostomy represents a serious inconvenience, and some sensitive individuals may prejudice their chances of recovery by rejecting this form of surgical aid out of hand, or after it has been carried out, may find it repugnant and importune the surgeon for restoration of normal bowel function. This difficulty may be formidable in the case of single young people who wish to be married. Certainly an ileostomy does not prohibit normal marriage relationships, and female ileostomy patients have borne children, but the barrier to marriage may be regarded as insuperable.

If, in such cases, the rectal disease is not too gross, it may be thought wise to say to the patient that an attempt will be made to conserve normal bowel habit. It is then stressed that an ileostomy will be necessary for the time being, and may be advisable always. The patient will, however, have the opportunity to weigh the discomforts of ileostomy against those of the disease and, in the event of failure, can either retain the ileostomy, or have it re-established.

Where there is gross rectal pathology such as perirectal suppuration, and fistulae, stricture formation, gross pseudo-polypoid changes, or any suspicion of carcinoma, no conservative approach can be countenanced and the patient is so informed.

METHOD OF ILEO-RECTAL ANASTOMOSIS

The method adopted is essentially an anastomosis of the ileum to the lower portion of the rectum following excision of the colon and the major part of the rectum. Consideration of safety has dictated temporary defunctioning of the bowel in the vicinity of the anastomosis by a proximal ileostomy. This permits the ileostomy content to thicken and for the ileum to take over some storage function before alimentary continuity is restored.

Stage 1—Preliminary ileostomy

A double barrelled ileostomy is carried out through a small vertical incision suitably placed over the right rectus muscle. The temptation to explore the abdomen is resisted but the ileum selected must be quite healthy in appearance. Adequate fixation is attained by sutures to the mesentery and no sutures are inserted in the bowel wall. A soft rubber tube is tied into the functioning limb of ileum so that it passes through the abdominal wall. This tube is made to pass directly without kinking to a drainage bottle attached to the patient's binder, and drainage continuity is tested by tube and funnel irrigation before the patient leaves the theatre. Tube drainage can then be maintained for a week to ten days until the sutures are removed and a suitable ileostomy bag is applied. The many details of ileostomy management have previously been described (Dunlop 1949). A low residue diet is regarded as essential in the early weeks of ileostomy.

Stage 2—Excision of the distal ileum, colon and proximal rectum. Defunctioning ileostomy

The ileostomy stomata are closed by purse strings and are dissected free from the abdominal wall. A long, left, lower, vertical, trans-rectus incision is made, and the ileum is clamped and divided above the preliminary ileostomy site. Total colectomy mobilisation is carried out in the usual way. In view of the not infrequent complication of subsequent small bowel obstruction following this operation, the writer endeavours to cover the raw areas in the flanks with peritoneum as snugly as possible.

On reaching the pelvic stage of the dissection, the patient is placed in the Trendelenburg position and the rectum is mobilised as in the abdominal stage of abdomino-perineal operation, except that as much pelvic peritoneum as possible should be retained.

The line of section of the rectum is designed to leave about one-third of this structure and no clamp is applied to the distal portion. An anastomosis is then effected end to end between the ileum and the rectal stump. Lateral guy sutures provide control of the rectal stump. The ileum should be freed sufficiently to be approximated to the rectal stump without tension or prejudice to its blood supply. It is approximated to the rectum with a rotation of 90 degrees, so that the mesentery lies laterally. The posterior row of interrupted sero-muscular sutures may be conveniently introduced with the ileum in a superficial, accessible position and it is then opposed to the rectum and the sutures tied. The two end sutures are temporarily retained long. A continuous all-coat suture of fine chrome catgut is then carried out. The anterior interrupted silk stitches are then

introduced. Reinforcing and peritonealizing sutures may be added by rotating the anastomosis by means of the lateral sutures. The peritoneum of the pelvic floor is then reconstituted with catgut so as to make the anastomotic line extra-peritoneal. Sometimes as in Case 4 it has been found to be easier to close the end of the ileum and to anastomose the side of the ileum to the end of the rectum by a similar technique. A soft rubber drainage tube is placed in position to drain this extra peritoneal area. The most direct drainage route appears to be the lower corner of the wound, in the suprapubic region. A defunctioning ileostomy of double-barrel type is then established through a small, separate, vertical incision. It is usually made over the left rectus muscle lateral to the main incision. The technique is the same as for the preliminary ileostomy. The wounds are then closed.

Stage 3—Closure of ileostomy

The ileostomy is freed from the abdominal wall by dissection. Adhesions are divided and the scarred and oedematous portions excised. End to end anastomosis is then effected with a suitable catgut all-coat suture, and interrupted silk Lembert sutures.

ILLUSTRATIVE CASE HISTORIES

Case 1—Mrs. D.C.

An attractive, sensitive, married woman, aged 30 years, was admitted to the Royal Melbourne Hospital on 11th January, 1949, with a diagnosis of non-specific ulcerative colitis. The first attack had occurred when she was aged 16 years and there had been various exacerbations and remissions. For the last nine months she had deteriorated steadily and had become bedridden for four months. Barium X-rays revealed diffuse changes in the colon typical of ulcerative colitis, and sigmoidoscopic examination revealed changes in the rectum of moderate severity.

Conservative surgical measures were not favoured, but she was unwilling to submit herself to surgery without extracting a promise that every avenue be explored for retention of normal bowel habit.

On 18th February an ileostomy was established through the right lower rectus muscle. Recovery was uneventful and her improvement in general health and vigour was striking. Total colectomy, excision of the upper two-thirds of the rectum, ileo-rectal anastomosis, and defunctioning ileostomy was carried out on 29th July. Her convalescence was smooth and further improvement in general health took place. Eight weeks after this operation, she suffered a small bowel obstruction due to adhesions and operative relief was necessary.

In September, 1950, barium X-ray demonstrated the rectal anastomosis to be quite patent and proctoscopy revealed only mild reddening of the rectal remnant.

On 15th September, 1950, detachment of the ileostomy and transperitoneal closure. The distal ileum appeared to be very narrow. After operation, the bowels did not open until the fifth post-operative day, by which time some anxiety was caused by colicky pain and some vomiting. This was succeeded by loose bowel actions, and prompt relief of pain. After a few days, bowel actions approximated 10 to 12 daily, and they then settled to 3 to 5 daily.

This patient has maintained very good health for nearly three years. She has gained approximately three stone in weight, has no rectal discomfort, and carries out normal household duties and social activities without embarrassment.

Case 2—M.B.

A recently married Nursing Sister, aged 29, was admitted to the Royal Melbourne Hospital on 18th February, 1951. She was known to have suffered from severe ulcerative colitis for sixteen months. Her previous history was of some interest.

Eight years before her appendix was removed. Five years later, or three years before her admission, an emergency operation was carried out for intestinal obstruction due to a band constricting the ileum, six inches from the caecum. Resection was not considered necessary. She remained gravely ill, and an abscess formed in the right ileac fossa. This was drained and a short circuit carried out between the ileum and the ascending colon. A persistent faecal fistula then necessitated a further operation. It was found that the ileum had sloughed away at about the site of the band obstruction. The open ends were mobilised and trimmed, and an end to end anastomosis effected. After considerable wound infection, recovery occurred.

For three years prior to admission, she had been troubled by polyarthritis, which particularly affected the small joints. For the last sixteen months, blood and pus had been noted in her stools. For four months there had been severe diarrhoea, with slime, blood and pus, and she had deteriorated steadily and lost weight.

After admission, despite energetic medical treatment and repeated transfusions, she continued to sink. Bowel actions were very frequent and she had a high swinging temperature with gross toxaemia. Her weight fell to 5 st. 10 lbs. There was marked abdominal pain, tenderness and distention. Barium clysma had previously revealed marked general changes typical of ulcerative colitis, and ulceration of the rectum, and general redness and oedema was visualised.

In the teeth of discouragement, she made a strong plea for retention of rectal function.

Preliminary ileostomy was done on 8th Mar. Four days later she bled severely from the colon. Resuscitation was successful and steady improvement then followed.

On 1st August total colectomy was performed with partial excision of the rectum (Fig. 1) low ileo-rectal anastomosis, defunctioning ileostomy. Excellent progress followed the operation. Subsequent barium clysma studies showed the lower bowel to be patent. The rectal stump was hyperaemic, but there was no obvious ulceration of the mucosa, and slow improvement occurred.

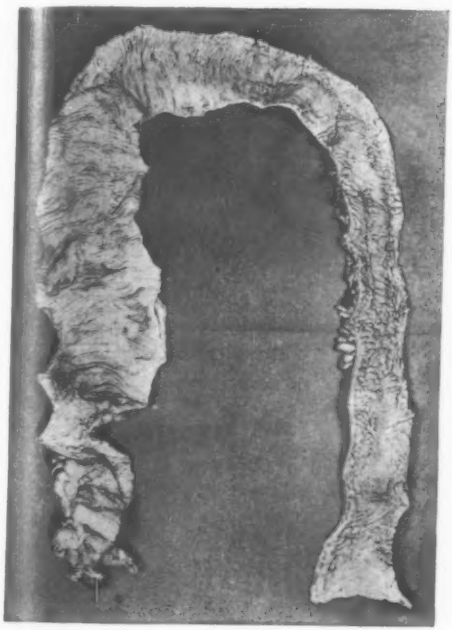

FIG. I. Case No. 2.—Photograph of operative specimen. Distal ileum, colon and portion of the rectum. Five months after preliminary ileostomy. There is only minimal disease in the rectum.

Closure of ileostomy was done on 21st November. There was some colicky pain preceding the opening of the bowels on the third post-operative day. Bowel actions were then frequent, ranging from 7 to 12 in the 24 hours. She has subsequently gained steadily in weight to 8 st., and leads an active useful life. She is quite continent. Motions are usually 2-4 daily. She is extremely pleased with her present condition and is still improving.

Case 3—D.A.

A sensitive student of music, aged 21 years, was admitted to the Royal Melbourne Hospital on 4th December, 1948. He was highly strung and cried readily. For six months, he had suffered from generalised abdominal pain and diarrhoea, characterised by 6 to 8 loose motions daily containing pus and blood. Four weeks prior to admission pain and tenderness was more marked in the right ileac fossa and this had led to a surgeon performing an unwise appendicectomy. Diarrhoea continued, and he remained very ill. Sigmoidoscopy revealed a hyperaemic mucosa which bled very readily. No actual ulcers were noted in the rectum. Grey sloughs and abundant blood and mucous were seen in the rectum. Barium clysma outlined general large bowel involvement typical of ulcerative colitis. No specific micro-organisms were isolated.

On 23rd December he weighed 6 st. 1 lb. Bowel actions average 10 daily. His abdomen was distended and there was rigidity and tenderness in the right ileac fossa. His temperature was 104° F. and pulse rate 130. Trial of several antibiotics and repeated transfusions had proved unavailing so that his condition was most critical. An ileostomy was advised, but surprisingly enough the main concern expressed was how this would affect his musical career. He was reassured that under all circumstances he should be able to continue his music.

On 24th December a double barrelled ileostomy was established in the right lower quadrant. Some thin free fluid was present in the abdomen. The indurated region about the caecum was not disturbed. Following ileostomy function, considerable improvement occurred.

On 7th January, 1949, an abscess with faecal content was drained by reopening the appendicectomy scar. Subsequent barium investigation outlined a fistula communicating with the caecum. Slow improvement continued and his weight rose to 8 st. 12 lbs. During this critical period of his illness, 30 pints of blood had been required. He continued to lose some blood from the bowel and the rectum appeared to be narrow, ulcerated and grossly hyperaemic. He desired the rectum to be retained at all costs, but was told that at that stage an anastomosis was most inadvisable.

The colon and distal ileum was excised on 5th July and the ileum brought out with the recto-sigmoid, double barrel fashion in the left ileac fossa. The specimen showed gross changes of chronic ulcerative colitis with pseudo-polyposis (Fig. II).

In subsequent months he became more determined to have the ileostomy closed, but in view of the raw, hyperaemic appearance of the rectum, this was opposed. He was finally told that, in view of his insistence, restoration of alimentary continuity would be considered after excising most of the rectum.

On 25th January, 1952, two-thirds of the ulcerated thick walled rectum was excised, ileo-rectal anastomosis was carried out and an ileostomy established at a higher level. In this case, the ileum was rotated through 180° in making the anastomosis. On 3rd March he appeared well and weight was 8 st. 12 lbs. The rectal anastomosis was patent, the mucosa was hyperaemic and bled readily, but some improvement had occurred.

Two days later the ileostomy was closed with some misgivings. By 16th Mar. his condition had become most worrying. He was febrile and sick and the abdomen was distended and tender below the umbilicus. The motions were blood stained and rectal examination revealed pelvic induration and tenderness. A laparotomy was carried out on 17 Mar.

Between 1 and 2 pints of foul pus was drained from the pelvis. Steady improvement then followed and drainage ceased.

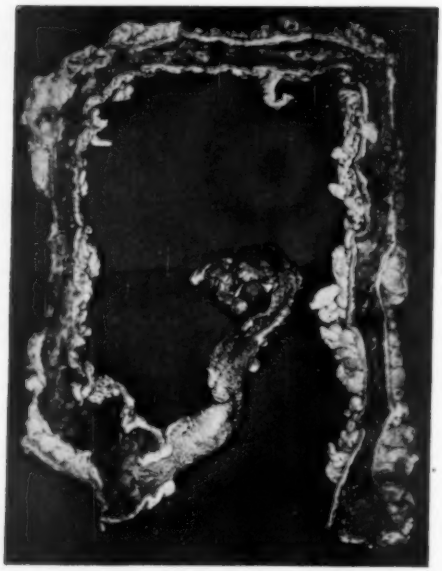

FIG. II. Case No. 3.—Photograph of operative specimen. Distal ileum and colon. Gross ulceration and pseudo-polyposis. The rectum was partially excised at a later date, and was less involved by disease.

On discharge from hospital on 19th April, 1952, the motions averaged about 8 daily.

At the present time he weighs over 9 st. and has excellent control of his bowel actions, which number 3 to 6 a day. He appears to be very well and is exceedingly pleased with his health and activity.

Case 4—Mrs. A.B.

An Englishwoman aged 52. Migrated to Australia twelve months before seeking surgical aid on 6th January, 1953. She suffered the first attack of ulcerative colitis seven years before, in which motions rose to 30 daily. After a period of remission she broke down and for eighteen months there had been progressive deterioration with very frequent stools containing pus and blood. She lost 3 stone in weight and felt weak and ill.

She was admitted to the Royal Melbourne Hospital where radiographic and other investigation confirmed the diagnosis of a diffuse non-specific ulcerative colitis. Sigmoidoscopy showed the rectum to be red and granular, but without gross ulceration or polyposis.

A trial of medical treatment, including blood transfusions and cortisone, did not improve her condition appreciably. On 12th February ileostomy was established. Her condition improved rapidly.

Total colectomy, low ileo-rectal anastomosis, proximal ileostomy, were performed on 23rd March. The end of the ileum was closed and the antimesenteric side anastomosed to the rectal end. The colon was thick, oedematous and congested. Ulcerative changes were more marked on the left side. The rectal mucosa was granular red and thickened.

Following operation she steadily regained health and vigour and the ileostomy content thickened.

Closure of ileostomy was done on 30th April. Healing was prompt and her general improvement has continued. The stools were very frequent during her hospital convalescence and are still up to 12 daily.

In view of her steady improvement she is not dissatisfied with her progress. It might have been wiser to have further delayed the closure.

DISCUSSION

It will be noted that in each of these cases the rectum was diseased and a "delaying action" was fought to give as much time as possible for recovery. Nevertheless in Case 3, the closure of the ileostomy appeared to be too hasty. Cases 2 and 3 were both difficult problems suitable for multi-staged procedure. Under more favourable conditions when the rectum is relatively uninvolved and especially when a remission can be secured by more recent medical methods, it would seem feasible to carry out a one stage excision of the colon and low ileo-rectal anastomosis together with the establishment of the defunctioning ileostomy as the initial operation. The ileostomy could then be closed as a second stage when conditions appear to be favourable.

Most patients find ileostomy much more tolerable than they expected. They are at least placed in a position subsequently to decide whether they prefer ileostomy or the discomforts of residual disease.

A criticism will certainly be made that so long as some large bowel remains, relapse may occur, even after many years. Some patients, however, are grateful for even a few years in which they may enjoy good health with anal function, and in the event of failure, they can revert to the ileostomy life.

In all cases of long-standing disease and particularly where pseudo-polypoid changes are present, the danger of malignancy must be given full weight. It is, however, illogical to regard this threat as of paramount importance in a disease in which surgery is, in any case, a line of treatment which is second-

ary to medical measures. Each case must be decided on its own merits.

There is also perhaps some inconsistency in that certain authorities who are willing to maintain an attitude of watchful expectancy towards the rectum, together with the use of diathermy to polyps, in cases of familial polyposis of the large intestine (in which the threat of carcinoma is very great), nevertheless oppose conservatism in chronic ulcerative colitis. In the latter disease, the risk is not so well defined and in any case, the lower portion of the rectum can be subjected to routine examination.

A single loop ileostomy is favoured by most surgeons in preference to a double barrelled opening, but where the ileostomy may be of temporary nature, it is a nuisance for the patient to contend with a separate opening, and dangers have been described when closed distal loops are returned to the abdomen.

In the first three cases described above, the approach has been cautious and the surgical stages rather protracted. The patients, however, returned to work in the intervening periods. It is hoped that it may be practicable, in selected cases, to establish an ileorectal anastomosis and defunctioning ileostomy without delay; but it is thought wise to delay the final closure for at least three months, and indeed only to effect closure when clinical and X-ray studies indicate favourable conditions.

SUMMARY

1. It is agreed that in severe cases of chronic ulcerative colitis, the safest and most satisfactory method of surgical treatment lies in complete excision of the large bowel and establishment of a permanent ileostomy.

2. In view of the fact that there are some sufferers from this disease who, despite the gravity of their condition, will not accept a permanent ileostomy as an initial, irrevocable measure, it appears wise to give some attention to measures designed to conserve alimentary continuity.

3. A method of ileo-rectal anastomosis by suture is described, illustrated by case reports, in which the lower bowel is temporarily defunctioned by proximal ileostomy.

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AN INTRA-ORAL PLASTIC PROCEDURE FOR MAXILLARY DEFECT

By Balcombe Quick

Melbourne

THE principle of the use of extra-oral tissue in the repair of some types of congenital palatal defect is now fully accepted. Although when first advanced (Quick, 1929) the method was derided by such an authority as Victor Veau as *un monstruosité chururgicale*, it is now advocated by Gillies as the method of choice in certain difficult cases of cleft palate.

FIG. I. Failed palate operation in infancy, with united soft palate but large anterior defect. A tubed pedicle graft is hinged on the lower lip.

In the case here reported an alternative is described in which, instead of any extra-oral source of tissue for the repair of a defect (conveyed to it by a pedicle graft as in Fig. I) adjacent material, in the tip of the tongue, was successfully employed.

The patient, a middle-aged man, an ex-steeplechase jockey, had incurred grave facial injuries in a smash some twenty years earlier in which the nose and considerable subjacent bone had been lost. He had also, he stated, sustained compound fractures of both clavicles leaving a good deal of scarring on both sides of the neck. A most successful rhinoplasty had been carried out by Sir Henry Newland, and an upper denture with an obturator closing a bony defect in the maxilla immediately above the alveolar margin was fitted. This obturator had never been completely successful and the return of fluids through the nose becoming increasingly embarrassing, he sought relief. Although the history appeared clear-cut, the presence of neck-scarring aroused certain doubts; the Wasserman reaction, however, proved negative. The defect from the bone loss of

FIG. II. The defect above the alveolus.

FIG. III. The tongue filling the defect.

maxilla and vomer measured $\frac{5}{8}$ inch by $\frac{3}{8}$ inch. The method of choice for its closure would have been by the use of a pedicle graft from the neck via the lower lip, but the scar tissue made this source unavailable. The tip of the tongue suggested itself as an alternative; it could readily be introduced into the defect as the upper jaw was edentulous.

FIG. IV. Closure.

It is unnecessary to describe the procedure in any great detail. Under intra-tracheal anaesthesia the tip of the tongue was sutured into the margins of the defect, after suitable refreshment, using chromic gut. Feeding presented no great difficulty. At the end of the first week an attack of sneezing resulted in partial detachment and it seemed that further repair would be difficult, but it was found that, under local anaesthesia, it was quite easy to insert further sutures, this time of silver wire with the help of silk carriers. Ten days later the tongue was divided leaving the terminal $\frac{3}{4}$ inch firmly obturating the defect. Loss of this amount of tongue involved no perceptible loss of function and the relief afforded was complete. The accompanying photographs illustrate the condition and the final result.

FIG. V. The post-operative tongue protrusion.

It is evident that a similar procedure might equally well be employed for a palatal defect, given a co-operative patient.

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CARCINOMA OF THE APPENDIX WITH REVIEW OF SIX CASES

By VERNON BARLING

Sydney

TRUE carcinoma of the appendix is a particularly rare condition. Lesnick and Miller, in 1949, could only find 17 cases in the literature which came into this category. Since that time another 9 cases have been added by Lawton and Ehrlich (1952), Marks and Whitaker (1950) and by Hughes (1951). It would seem that some 30 cases of undoubted appendiceal carcinoma are all that have been reported to date.

A personal case report

C.F., a 66 year old engineer, was admitted to Royal Prince Alfred Hospital on the 8th March, 1953, with the history of having had a mild pain in the right lower quadrant of the abdomen for nine days. In the last thirty-six hours it had occurred with greater severity, being stabbing in nature.

FIG. I. Portion of terminal ileum, caecum and appendix. The proximal portion of the appendix is opened to show the carcinoma. The remainder of the appendix is gangrenous.

He had had no other symptoms referable to the alimentary tract, nor, indeed, to any other system. He stated that he had had a right inguinal hernia for four years and that in the last few days this had become irreducible and slightly uncomfortable, though no local soreness had been felt. His previous health, habits and family history gave no relevant information.

Physical examination revealed a person of somewhat younger appearance than his age stated, and in no apparent discomfort. The temperature was 102° Fahrenheit, pulse rate 120 per minute and blood pressure 130/80 mm. of mercury.

Marked tenderness, rigidity and rebound tenderness were present over the right quadrant and less markedly so in the left lower quadrant.

There was a partially reducible right inguinal hernia, which was not tense nor tender, and a cough impulse was still present. The content appeared to be omentum.

Rectal examination revealed tenderness of the pelvic peritoneum at all areas.

The blood count showed a haemoglobin value of 14.2 gm. per cent., a white cell count of 10,450 with 68 per cent. neutrophils and 30 per cent. lymphocytes, 2 per cent. monocytes.

Analysis of the urine revealed a specific gravity of 1010, alkaline reaction to litmus and a cloud of albumin.

A diagnosis of acute appendicitis with rupture and pelvic peritonitis was made, though torsion of the great omentum was also considered as a possible diagnosis. Under general anaesthesia the abdomen was palpated prior to laparotomy. It was found that a lump was now clearly discernible under McBurney's point and that this extended down to the level of the inguinal ligament. Feeling that an appendiceal abscess was the most likely diagnosis, the abdomen was opened through a McBurney's incision. The caecum was indurated and fixed to the posterior abdominal wall, the appendix, however, was found reasonably easily, was enlarged to the size of two fingers, being gangrenous in its distal two-thirds and very much thickened at its base. There was no sign of localization of the infection in the form of an abscess cavity, and, though the great omentum was passing across the region down into the right inguinal canal from which it could be extracted, this had not prevented purlent fluid from passing down into the pelvis and across to the left side of the peritoneal cavity. The great omentum showed no sign of torsion and it was thought better to leave it plugging the internal inguinal ring region. The terminal ileum was distended and appeared obstructed. Hence, it was decided to perform a Mikulicz-Paul resection of the terminal ileum, ascending and proximal transverse colons. This was carried out through the original incision enlarged transversely and a full right hemicolectomy adequately performed, regional glands being noted along the ileo-colic vessels. The ends of the ileum and transverse colon were kept clamped and the right paracolic gutter drained.

The patient went steadily downhill post-operatively. A combination of chronic nephritis and a copiously active ileostomy made his fluid and electrolyte balance a problem of some difficulty and he died on the eleventh post-operative day.

No post-mortem was allowed.

Pathological report (Dr. V. J. McGovern)

The specimen consists of the terminal ileum, portion of colon, caecum and appendix. The terminal half of the appendix is gangrenous and there is an exudate over the surface. The base of the appendix is greatly thickened and, on section, this is seen to be due to carcinoma which completely encircles the appendix and extends for a slight distance into the caecum. The mucosa at the junction of the appendix and caecum is oedematous. There is carcinoma present in the ileo-caecal lymph nodes.

Microscopically, the lesion is an adenocarcinoma and in the ileo-caecal mesentery there is a similar adenocarcinomatous infiltration.

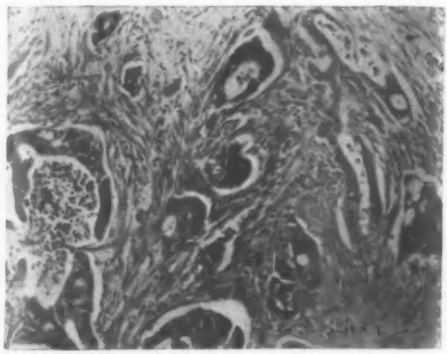

FIG. II. Photomicrograph showing the adenocarcinoma with cicatrization. Haematoxylin and eosin. (x 150)

Examination of the medical records of the Royal Prince Alfred Hospital reveal only 5 other undoubted cases of carcinoma of the appendix since 1910. Brief notes of these cases are appended.

Case 2

A female patient, aged 39, admitted in 1931 with a history of:—

(1) Loss of weight—1 stone in six months.

(2) Peri-umbilical pain for one month.

(3) Absolute constipation for three days.

There was a previous history of papilloma of rectum having been removed ten years before.

On examination there was a fixed, craggy mass in the right lower quadrant of the abdomen with distension in the remaining quadrants with ladder pattern of the small intestine and visible peristalsis.

On vaginal examination the mass in the right lower abdomen was thought to be attached to the uterus.

Laparotomy revealed an appendiceal carcinoma with spread to the caecum. Sub-peritoneal nodules were present on the ileum. The appendix was fixed to the uterus. Ileostomy was performed as the patient's condition went off under anaesthesia.

Death occurred forty-eight hours after laparotomy.

Post-mortem report (Dr. Geoffrey Davies)

The whole appendix is thickened and infiltrated with carcinomatous growth and this appears to have been the primary site with secondary spread to caecum. Carcinomatous nodules are present in the uterus in the sub-peritoneal layer. The growth is an adenocarcinoma of low grade malignancy. Multiple polyposis of the colon is also present.

Case 3

M.W., a female, aged 38, admitted in 1931 with a faecal fistula, following drainage of an "ovary cyst" some ten weeks previously. Two weeks post-operatively swelling of lower abdomen had recommenced and swelling of the ankles appeared.

The patient was in extremis on admission with weakness, vomiting, dyspnoea and palpitations.

Examination revealed an emaciated woman at the lower end of whose midline sub-umbilical scar was a fistula leaking copious quantities of thin faeces. A hard, fixed mass was present in the right lower quadrant of the abdomen.

On vaginal examination, the uterus appeared attached to the abdominal mass. The patient died within twenty-four hours of admission.

Post-mortem report (Dr. Geoffrey Davies)

A tumour mass is present in the lower right abdomen which, on section, is cavitated. From the caecum, which is displaced upwards, the orifice of the appendix can be traced into the tumour cavity. This cavity connects with the terminal ileum, and the skin at the lower end of the section scar. There is a collar of carcinoma around the appendix. The tumour displaces but does not invade the pelvic viscera. Microscopical sections show an adenocarcinoma with mucoid change.

Case 4

M.C., aged 30, admitted in 1931 for recurrent appendicitis.

At operation, the appendix was noted to be thickened and indurated. Section revealed adenocarcinoma pervading the wall, but at least 2 cm. from line of section of appendix. Prophylactic irradiation was gvien but no hemi-colectomy was done.

The patient was readmitted in 1932 with symptoms of one month's duration of:—

(1) Swelling of ankles.

(2) Extreme dyspnoea on exertion.

(3) Lump in lower right abdomen.

(4) Right supra-clavicular glandular swelling.

Paracentesis of the abdomen was performed twice but the patient's condition gradually went off and she died ten days later.

X-ray therapy to abdomen and neck was suggested but not carried out. No post-mortem was carried out.

Case 5

F.N., aged 52, was admitted in 1935 for hysterectomy for myopathic uterus.

Routine total hysterectomy, double salpingo-oophorectomy and appendicectomy was carried out.

Pathological report

Longitudinal section of the appendix shows a fairly abrupt narrowing near the tip with a few thread worms in the lumen of the proximal part. At the narrow portion there is infiltration by carcinoma forming a stricture. Section of the tip shows invasion of intra-mesenteric fat by carcinoma cells. Microscopically, the sections showed adenocarcinoma.

Case 6

M.B., aged 75, admitted in 1950. There was a history of pain in the right hypochondrium for six months, with, in addition:—

(1) Pain severe for one day.
Radiation to epigastrium from time to time.
No relationship to meals.

(2) No back pain.

(3) No jaundice nor urinary symptoms.

(4) Constipation for five days.

There was muscle guarding and tenderness over lower abdomen and extending up right paracolic gutter.

At operation, matted loops of small intestine were found in the right iliac fossa surrounding a gangrenous appendix. Pus was present in the right paracolic gutter. The caecum was hard and infiltrated. Appendicectomy with drainage was performed. Peritonitis ensued with a caecal fistula on the fourth post-operative day.

Post-mortem revealed a caecum just invaded by adenocarcinoma of the proximal appendix with invasion of the mesoappendix.

No metastases in lymph glands or liver were noted.

DISCUSSION

Carcinoma of the appendix is a very rare condition, and in the past confusion has existed in the definition of such lesions, but most authors now classify tumours of the appendix into:—

(1) Carcinoid (benign and malignant).

(2) Mucocoele and cystic mucinous carcinoma.

(3) Adenocarcinoma of colonic type.

Carcinoids classically are single or occasionally multiple nodules, yellowish in colour and hard in consistency which project either on to the serous or mucous surface of the appendix. In these the mucous membrane over the tumour is intact, and microscopically there is no mucus secretion by the tumour cells. Mitotic figures are few. The cells of the tumour have an affinity for chrome salts and reduce silver salts. They are found predominantly near the tip of the appendix. Their incidence is 88 per cent. of appendiceal tumours. Metastases, though noted from time to time, are rare. Hopping collected 16 instances of carcinoid metastases.

Mucocoele of the appendix may well be the result of non-malignant obstructive lesions of the appendix, and, indeed, Willis (1948) has gone so far as to state that pseudomyxoma peritonei following a cystic carcinoma of the appendix is purely the result of obstruction and not of invasion of the peritoneum by carcinoma cells. Woodruff, however, is of the opinion that pseudomyxoma peritonei is the sequela of adenocarcinoma of the appendix of low grade malignancy. In this form the appendix is dilated with mucus and the epithelium thrown into folds. Spillage of the mucus content is always a risk at operation and peritoneal seeding a definite danger. Their incidence is 8 per cent. of appendiceal tumours.

True adenocarcinoma of the appendix of colonic type constitutes 4 per cent. of appendiceal tumours. It takes the form of an ulcer or polyp more often at the base than at the tip of the appendix. An ulcerative lesion may initially cause occult bleeding and anaemia, a polyp more likely obstruction. Microscopically, such lesions may be well differentiated with glandular appearances, or frankly anaplastic. Spread occurs via the lymphatics and blood stream, and local spread into the base of the caecum will

often make the location of the primary site of the carcinoma open to doubt.

The frequency of carcinoma at the base of the appendix makes the clinical picture commonly presented, one of the obstructive appendicitis, and no reported case has been diagnosed pre-operatively.

At laparotomy, the diagnosis may still be in doubt and appendicectomy performed, with an indurated appendix the only suggestion of carcinoma. In these cases microscopic section will reveal the true state of affairs and the presence of anything more than a minimal lesion will determine the necessity for more radical measures, right hemicolectomy being the procedure of choice. The advantage of frozen section under these circumstances is apparent.

Again, routine appendicectomy may give the surprise microscopic diagnosis of adenocarcinoma as in Cases 4 and 5. In Case 4 this was followed by extensive peritoneal and lymphatic spread within one year, whilst, in Case 5, the patient still survives—eighteen years after the appendicectomy. Experience with carcinoma generally suggests that the outcome may still have been the same in Case 4 even had right hemi-colectomy been performed immediately the microscopic diagnosis was made. Instead, prophylactic X-ray therapy was instituted. Experiences such as this dictate a policy of right hemi-colectomy for carcinoma of the appendix whenever diagnosed.

Finally, at operation, the diagnosis may be obvious as in Case 1. Immediate hemicolectomy should be avoided in cases such as this where spreading peritonitis is present. A happier outcome could have been expected had a primary short circuiting procedure such as ileo-transversostomy been performed with drainage of the appendiceal region. Later, hemi-colectomy could have been performed.

The spread to the pelvic adnexae as noted by Waugh and Findley was found in Cases 2 and 3. This should be looked for and hysterectomy and salpingo-oophorectomy combined with hemi-colectomy where necessary.

The necessity for examination of all material removed at operation is particularly exemplified in the way in which carcinoma of the appendix is often only thus discovered (Case 5).

SUMMARY

(1) Carcinoma of the appendix is a rare condition.

(2) A further 6 cases are added from the records of Royal Prince Alfred Hospital.

(3) This small series emphasizes the following features:—

(a) Accurate pre-operative diagnosis has never been recorded. Appendicitis is the commonest pre-operative diagnosis made.

(b) Diagnosis may be made only when routine microscopic examination of an apparently blameless appendix is carried out. Hemi-colectomy is probably the best treatment in such an event, though one case here presented has survived 18 years without further operation. At laparotomy in doubtful cases, hemicolectomy may be delayed until microscopic examination of the appendix demands such a step—a frozen section in the theatre will usually decide the necessary procedure.

(c) If diagnosis be definite at laparotomy, then hemi-colectomy should be done in the absence of peritonitis. Where peritonitis is present, ileo-transversostomy and drainage of the appendiceal region should be performed. Hemicolectomy can then be performed in two to three weeks time when bowel preparation has been adequately effected.

(d) An ileostomy (as part of Mikulicz-Paul procedure) can be a fatal factor in dealing with such cases, especially when they are elderly.

(e) Excision of the uterus and pelvic adnexae may be necessary due to pelvic spread.

ACKNOWLEDGEMENTS

I am most grateful to the members of the Honorary Staff of Royal Prince Alfred Hospital, under whom the last 5 cases were admitted, for permission to publish details of their histories.

The Staff of the Medical Records Department, Royal Prince Alfred Hospital, have been most helpful in searching the records for these cases.

Dr. V. J. McGovern has provided stimulating criticism.

I am indebted to Mr. Woodward Smith for the photographs of specimen and microscopic section.

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MEGAURETER

By F. Douglas Stephens

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THIS study was begun at the Hospital for Sick Children, London, where I was privileged to work from 1948 to early 1950 as Surgical Research Fellow. It has been continued at the Royal Children's Hospital, Melbourne, during the past three years.

Megaureter occurs in a wide variety of diseases. In some the cause is readily apparent. Such conditions as urethral obstruction, ureterocoele, frank uretero-vesical stricture, impacted calculi and obvious neurological disorders such as meningo-myelocoele are well recognized causes and the management varies with the nature of the primary lesion. There is, in addition, a group of megaureters in which it is not always possible to demonstrate a local uretero-vesical stricture, even though by X-ray the column of iodide in the ureteral lumen is occluded at or near the intramural course. It is the clinical recognition and management of this group rather than its aetiology that this paper is chiefly concerned.

Definition

The megaureters mainly showed lateral as opposed to longitudinal dilatation, were bilateral, and presented at or near the uretero-vesical junction no easily recognizable organic stricture to correspond with the filling defect demonstrable at this site on ureterography.

In this study, this special group of patients with megaureter were further subdivided by micturition cysto-urethrography into those that permit vesico-ureteral reflux and those that do not. For the purposes of this paper the groups are called megaureter with reflux and megaureter without reflux.

Material

In the reflux group there were 13 patients, of whom 11 were females and 2 were males, ranging in age, on presentation, between ten days and thirteen years. There were two deaths. In the group without reflux only three cases were available for study, two being males and one female, between the ages of seven months and six years on presentation. There were no deaths in this group.

The longest period of observation was two and one half years in the group with reflux, and four years in the group without. In one child in the group without reflux, X-rays were available extending over a period of five years, but the 3 children were actually observed for from two to four and one half years.

Micturition Cysto-Urethrography

Technique used in this study

The patient lay on the X-ray table in the supine position to avoid the effects of gravity. The bladder was filled with 16 per cent. Uriodone using a small catheter (size 3 or 4 English gauge), tube and funnel, after which the catheter was removed.

The bladder was filled gradually and films were taken during filling and then during emptying. The bladder outline and the mural contours of the bladder neck and urethra were studied during filling and emptying. When reflux occurred, the ureter and, in some, the pelvis and calyces of one or both kidneys, were outlined by iodide during the resting stage or early or late in micturition. In babies, the bladder was filled to capacity to produce urgent desire to micturate, when evacuation began spontaneously, permitting one or two films only during micturition.

During the micturition procedure, the child, if co-operative, was asked to stop and restart several times, though sometimes arrest of micturition was assisted by manual compression of the urethra by the operator, to allow time to change the films and to change the position from antero-posterior to oblique or lateral.

Residual films were then taken; the first immediately on termination of micturition, then after one minute, after which the child was asked to micturate again, and a further film was taken immediately. A further short period of approximately two minutes was allowed to pass, and then a further film was taken, after which the patient was asked to pass the bladder content once again. Another immediate post-micturition film was taken. This was repeated until the ureters were emptied completely, usually requiring two or three efforts of micturition. The quantities of urine passed on all occasions were measured. Thirteen children with megaureter were in the reflux group, and three were in the group without reflux.

MEGAURETER WITH REFLUX

Most of the observations made at micturition cysto-urethrography of this group are illustrated in Figs. I-X of the girl, D.A., aged 7 years. They are as follows:—

(1) Reflux occurred during filling, early in some but more towards the completely full stage in others or during emptying, and often up one side more than the other (Fig. I).

(2) With continued filling of the bladder, the ureter may partly empty its content back into the bladder, and spontaneously refill (Fig. II), suggesting free efflux and reflux.

(3) The bladder outlines were smooth. In one patient, two very small, split-pea sized juxta-ureteral diverticulae were apparent. Urethra and bladder neck were normal in outline (Figs. III, IV).

(4) During micturition, further reflux occurred, usually up both ureters. The amount of reflux varied from case to case and from side to side in the one individual (Figs V).

(5) The ureters were dilated and elongated, and somewhat tortuous, but the enlargement was mainly lateral as opposed to longitudinal. The pelves and calyces frequently escaped dilatation, and in 3 children, on one side only, the calyces were bunched together, suggesting some degree of hypoplasia of the kidneys. During the cysto-urethrography studies, clubbing frequently occurred during the stages of maximum reflux and reverted to a cupped appearance in the more empty phases (Figs. V and IX).

(6) The bladder emptied completely except in 2, in whom there was still a small amount of iodide in the bladder (probably less than an ounce). Its significance was inconclusive, as the children were unable to restart micturition with so little in the bladder.

(7) The bladder expelled its contents through the urethra, but also into the ureters to an amount depending on the dimension of the ureter and the incompetence of the uretero-vesical orifice. This reflux content of the ureters was expelled back into the bladder within a few seconds of micturition (Figs. VII and IX). After 3 successive acts of micturition with intervals of approximately two minutes, the ureters were completely emptied (Fig. X). The volumes passed were measured and the second and third amounts were constant in repeated estimations. In some cases, the ureters were emptied in two successive efforts. Without the assistance of gravity, the ureters had the power of completely expelling their contents within a period of approximately six minutes if the bladder was voluntarily emptied in successive attempts spaced at approximately two minute intervals (Fig. X.)

(8) The columns of iodide in the lower ends of the ureters were obliterated at the intramural course (Fig. IV). In one case, a spiral narrowing of approximately 0.5 cms. length preceded the final obliteration of the column at the intramural site.

(9) Over periods ranging from six months to two years, repetition of cysto-urethrographic studies indicated that there was no noticeable increase in the dilatation. In two it appeared to be less, and in one the reflux occurred more up one ureter than it had done in the previous occasion.

(10) A transvesical bilateral meatotomy had been performed on one child (E.R., Table 1) in this series with extreme degrees of megaureter. It is not known whether reflux occurred prior to the operation, but very free reflux was observed subsequently. On repeated micturition the bladder was completely emptied, but after 3 attempts there was still a small amount of iodide present in the lower ureters or bladder.

Intravenous pyelography

The iodide concentration in the calyces and pelves was, in most cases, good in the early films, and the iodide shadow appeared in the bladder within ten minutes.

Cystoscopic appearances

In this group of cases, the bladder showed none of the trabeculations so markedly apparent in the hypertrophied bladder of urethral obstruction. The ureteric orifices were clearly and easily seen on this pale, smooth background of trigone and bladder, except in one where infection caused reddening and oedema of bladder base.

The cystoscopic appearances of the ureteric orifices in this series varied from case to case, and from side to side in some of the individual children. The orifices were described as normal, normal except for the moment of discharge of fluid when a small central dark spot appeared denoting a wider calibre than usual, a winking incompetent thin camera-like diaphragm which never completely occluded the lumen, and finally the frank enlarged patulous orifice with a dark lumen. In one case the orifices were normal in size, but each was accompanied by a faint shallow dimple which on discharge of urine was taken up into the orifice to give the appearance of an enlarged ureteric orifice. This showed very small diverticulae on the micturition cysto-urethrogram. Ureteric catheters passed with ease. No difficulties were experienced in catheterizing these orifices with varying calibre catheters, and in one, six catheters were passed into the orifice.

In correlating the cystoscopic appearances with the radiographic evidence of reflux in this series, it appeared that the more normal the orifice the less the reflux which occurred mainly during micturition, whilst the patulous type permitted reflux early or later in the filling process of the bladder, and even more during micturition.

MEGAURETER WITHOUT REFLUX

Cysto-urethrographic observations

This investigation disclosed a normal bladder and urethra, with complete absence of residual urine.

Retrograde ureterography

In this group, of necessity the dilatation of the ureters was assessed by the retrograde pyelo-ureterography, as well as by intravenous pyelography. Special note was made of the emptying times of the ureters in 2 cases after retrograde injection. When assessing the emptying times the bladder was drained immediately after injection of the iodide to remove any iodide which overflowed into the bladder and to avoid the masking effect of the dilution of iodide by the fluid already in the bladder.

The ureters were dilated, chiefly laterally and in the lower segments, and to a lesser degree the pelves and calyces were affected. Change in shape of the ureters suggestive of peristalsis was observed on X-ray films in 2 cases. The lower ends of the ureters were steeply coned to points approximating their sites of enry into the walls of the bladder; here the iodide columns were obliterated in five of the six ureters in these 3 children. The sixth ureter at its lower end resembled radiographically a spiral narrowing for 0.5 cm. below the tip of the cone before entering the intramural vesical segment. The appearance of iodide in the bladder after retrograde filling of the ureters in the anaesthetised child (2 cases) was delayed. In one child, after retrograde ureterography, iodide was recognized in the bladder only after one hour, and in another child, after twenty minutes. In these 2 children the ureters still contained iodide after two hours and half an hour respectively. The emptying times of the ureters were grossly protracted.

The emptying times of the ureters after retrograde injection helped in assessing the obstructive element as a cause of the megaureter without reflux.

Intravenous pyelography and ureterography

The ureters were less clearly seen because of the dilution of the iodide by the content of the ureters, but the general configurations were similar to the retrograde ureterograms. In these 3 children the iodide was first recognized in the bladders in intravenous pyelogram series in minimum times of ten, twenty and thirty minutes.

The degree of dilatation showed slow progressive increase in two of the cases over periods of three years and eleven months respectively, and in the third progression was indefinite over a five-year period, but in this child, early in the period of observation, both ureteric orifices had been dilated per urethram.

Cystoscopic appearances

The ureteric orifices appeared normal in one case, patulous but contractile in another, and in the third, one orifice looked normal and the other resembled a linear crater with crenated edges.

Ureteric catheters were passed into the ureters in all 3 children. In one child the calibre is not known, in another size 6 French bougie passed with ease, and in the third, the right ureter presented no difficulty to size 6 French bougie, but this bougie entered the linear crater-like lumen of the left orifice but could not be passed further, and a size 3 French catheter was introduced with ease.

It was found that cystoscopic findings in the two groups of megaureter overlap and except in the extreme gaping variety were not helpful in differentiation of the two types.

EMPTYING TIMES OF URETERS

The emptying times of the ureters in both groups have been estimated. In the reflux group the estimations were made on the unanaesthetised child but in the normals and in the megaureters without reflux, they were assessed in the course of routine retrograde pyelo-ureterograms under anaesthesia.

Campbell (1951) states that the pelvis of the normal child usually empties itself in two to four minutes and sometimes earlier—"Trap" films taken after withdrawal of the ureteric catheters should show emptying of the upper urinary tract within ten minutes.

A study by the "trap" film method of the normal ureters of 9 children demonstrated almost complete emptying of pelvis and ureters in five minutes, though in some there persisted a faint mural coating of the pelvis in ten minutes. These findings support those of Campbell.

The megaureters with reflux were shown to be emptied in the co-operative child, within six to ten minutes if the bladder was emptied by the triple micturition technique. Two of these children were again examined by cystourethrography which was done by a slightly different technique. After all the iodide was expelled from the bladder without interruption, a large catheter was inserted into the bladder to drain off the iodide which collected in the bladder by discharge from the ureters, to prevent further vesico-ureteral reflux. In one the ureters were observed by fluoroscopy to empty almost instantaneously, and in the other (D.A., whose previous cystourethrogram series is shown in the illustrations) the upper urinary tracts were emptied in two minutes except for a faint mural coating which was still apparent at six minutes.

The 2 children with megaureter without reflux, when examined by the "trap" film method showed iodide first appearing in the bladder after one hour and after twenty minutes respectively and even more protracted emptying of the ureters.

From these observations it was concluded that in the reflux group, there was no delay in emptying of the ureters and therefore no obstruction at the uretero-vesical junctions. In the group without reflux, emptying was protracted suggesting an obstructive mechanism in the lower ends of the ureters.

CLINICAL PATTERNS OF THE TWO GROUPS

Clinical findings in megaureter with reflux

Symptoms typical of urinary tract infections were present in 12 of the 13 cases in the reflux group. In eleven, *Escherichia Coli* was the causative organism, and in one there was a mixed infection including this organism. The infections were recurrent, in one occurring two to three times yearly for seven years, causing chronic ill-health, and requiring specific chemotheraphy to stop the attacks, and in others the infections had been recurring for shorter periods (Table 1).

The age of onset of infection varied from ten days to six years, though in 8 it was under two years.

Enuresis by night and sometimes by day was a prominent symptom in 6 children, though in the remainder this information is not known, or is irrelevant owing to the early ages of the children. The enuresis was worse during attacks of pyuria.

Loin pain was a factor in only two cases, one with and one without infected urine.

Retardation in growth was apparent in three of these children, severe in one and moderate in two.

The blood pressure was normal for age in 6 and not recorded or considered not reliable in the remainder. The blood urea was normal in all except one in whom the figures of 59 and 52 mgms. per 100 cc. were registered.

This patient with the raised blood urea was severely retarded in growth. His case history is reported with illustrations by Higgins, Williams and Nash (1951). He subsequently died from pneumonia during his seventh year, but no post-mortem examination was carried out.

The cause of death in the baby who presented at ten days and died at forty days was severe urinary infection. No instrumental investigations were carried out before death, but on post-mortem examination the ureteric orifices were widely dilated and presented no evidence of obstruction. The calibre of the right ureteric orifice was 0.5 cm. and the intramural course was 0.1 cm, after which the lumen widened suddenly to 1.2 cm. The left orifice was 0.1 cm. wide, the intramural course was 0.1 cm. long and the ureter outside the bladder was approximately 1.0 cm. in diameter.

Clinical findings in megaureter without reflux

The symptomatology of the group without reflux was confined in this series, admittedly too small to form a pattern, to intermittent haematuria in two cases and loin pain of fairly severe nature in one, as presenting symptoms. In two the urine was sterile and in the third there was pyuria, and the organism was *Escherichia Coli*. In this child, a female, there was in addition to the haematuria and pyuria, some vague loin pain and enuresis. The blood pressure was normal in one, and not recorded in two, and the blood urea was normal in all three. There was no retardation of growth.

TREATMENT

Megaureter with reflux

In this group the pre-eminent objects of treatment were sterilization of the urine and removal of the residual urine content of the ureters and bladder. Selective chemotherapy was usually adequate to sterilize the urine. The removal of the residual urine was the most important factor in support of chemotherapy and in prevention of recurrence of infection. This was adequately accomplished by "triple micturition" therapy.

"Triple micturition" demands the co-operation of the child. As shown on the X-ray series (Fig. VI), the bladder emptied completely after which the dilated ureters discharged some of their content within two minutes, back into the bladder. Further evacuation of the bladder still further emptied the urinary system, and a third micturition after two more minutes almost completely emptied the system. The amounts of urine passed on each occasion in the triple micturition were usually very constant. By training the child to micturate on three successive occasions at the one sitting, with approximately two minute intervals between (four minutes for the total) it was found that the urinary system could be kept free of residual urine.

In order to protect the kidneys from the mounting pressure of the bladder, triple micturition should be regularized by the clock to shorter intervals than would otherwise occur by natural stimuli; e.g., two-hourly intervals in the under four age group, three-hourly in the under eight, and four-hourly in the older children.

For the very young children and babies where co-operation was not forthcoming, the infection was treated by chemotherapy. Observations of the progress of the dilatation of the calyces determines the need for further treatment. If there is obvious progression of the dilatation, and if infection is chronic and cannot be controlled by chemotherapy, a temporary supra-pubic drainage is indicated, though it was not performed in any subjects in this series.

Results of treatment

Six girls between the ages of four and thirteen years with reflux megaureters have undergone the triple micturition regime for periods between one and two and a half years. Five have been entirely free of infection and are healthy children. All show a dramatic and most pleasing improvement in health beginning at the onset of triple micturition (Table 1). One child developed a recurrence of urinary infection, due in part to failure to carry out the regime faithfully. A seventh child who has had chronic pyuria for two and a half years has recently begun treatment and is now pus free for the first time. This child has been classed as megaureter with reflux because of the free reflux that occurs now, but originally two years previously she had had bilateral transvesical ureteral meatotomy performed.

DISCUSSION

The clinical subdivision of idiopathic megaureters into the group with vesico-ureteral reflux and that without reflux defies allocation of all their members to any one subgroup of the current classifications which lay down certain specific features as their criteria. The reasons for adhering to this clinical subdivision are its application in the "triple micturition" management which has been successful in reflux groups and its assistance in distinguishing those in which obstruction at the vesico-ureteral junction is absent (reflux group) from those in which it is present (non-reflux group).

From observations by cysto-urethrography on megaureter with vesico-ureteral reflux, it appears that the uretero-vesical junction is incompetent. In megaureter without reflux it is competent but even to the extent of hindering the passage of urine in its normal direction. Estimations of the emptying times of the ureters in the latter group has shown considerable delay.

TABLE 1

BILATERAL MEGAURETER WITH REFLUX

Case No.	*Initials*	*Sex*	*Age of onset of symptoms*	*Age at time of triple micturition treatment and remarks*	*Duration of triple micturition treatment*	*Number of attacks of urinary infection prior to treatment by triple micturition*	*Number of attacks subsequent to beginning of triple micturition*
1	D.Y.	F.	5 years	11 years 8 months	1 year 3 months	Minimum 3 per year for six years	Nil
2	J.K.	F.	1 year 6 months	9 years	1 year	Urinary infection for seven months and probably longer	Nil
3	W.W.	F.	1 year 6 months	9 years	1 year 1 month	2–3 attacks per year for two years and attacks last two months	Nil
4	E.R.	F.	11 years	15 years	weeks only	More or less continuous infection for two years	Now pus free
5	T.D.	F.	2 years 3 months	4 years	1 year 7 months	Many attacks over fifteen months	Nil
8	D.A.	F.	10 months	5 years 9 months	1 year 6 months	Continuous infection for six months	Nil
9	V.W.	F.	1 year 4 months	4 years 8 months	1 year 1 month	6 attacks in six months suggestive of pyuria and pus found in last attack	One

Megaureter without reflux

In group two, the delay in emptying of the ureters in the presence of contractility of the ureters is presumed to be due to obstruction at the lower ends, and should be treated by some form of conservative operation. If reflux occurs as a result of treatment, regular triple micturition by the clock may succeed in preventing infection.

Some of the reflux group fall into Group 5 of the classification of Higgins, Williams and Nash (1951) in which the criteria are bilateral megaureters with dilated patulous

ureteric orifices which they describe as "ear trumpet" in type.

With some variation in the description of the ureteric orifices the non-reflux group would fall mainly into the Group 4 in which the criteria are a normal uretero-vesical junction and lower urinary tract. They describe the radiological appearances of the narrow or normal calibre terminal segment of the ureter as being up to an inch in length or shorter and confined to the intramural ureter. The radiological narrowing in these children lay in the intramural segment in 5 of the 6 ureters, and for approximately 0.5 cm. longer in the sixth.

The treatment suggested by these authors for Group 5, in which some of the reflux group fit, is sterilization of the urine. For Group 4, which probably includes some of the group without reflux in this series, sterilization of the urine and conservative surgery to the obstructive terminal ureter are the principles of treatment offered.

Caulk (1923) relates the findings in a female patient aged 32 years with giant bilateral megaureters but with relatively slight degrees of hydronephrosis. The ureteric orifices were normal, the left ureter and bladder containing pus, *Escherichia coli* and *staphylococci*. The right ureteric specimen was described as normal. From these observations one assumes that the megaureter on the right side at least did not permit reflux from the bladder in its original state but cysto-urethrography was not done to prove it. This patient would presumably fall into the group without reflux. Ureteral meatotomy appeared to improve the kidney function and ureteral emptying.

Swenson *et alii* (1951) believe that megaureters are associated in some instances with "megalobladders." In these patients the primary defect is ascribed to the bladder. A diminution of the parasympathetic ganglion cells in the walls of the bladder causes imperfect detrusor function. These authors state that "the patients usually had large urinary residuals so that the ureters injected urine into the bladder with intravesical pressures from two to three times higher than normal." They believe that the dilatation of the ureters was secondary to the bladder disorder with its raised intravesical pressures, and directed treatment to the bladder. Temporary supra-pubic drainage and then micturition at least 4 times daily aided by supra-pubic pressure to accomplish complete emptying of the bladder resulted in considerable reduction in the size of the ureters and improvement in these patients.

Campbell (1952) divides megaureter into primary and secondary forms. Primary megaureter is characterized by relaxed immobile ureteral orifice, altered ureteral dynamics, wide ureteral dilatation predominantly lateral, free vesico-ureteral reflux and no evidence of obstruction, neuro-muscular vesical disease or advanced infection. He claims that the primary type is rare, but that the criteria which are usually applied to this group conform to a secondary type of megaureter with neuro-muscular vesical disease which, in most instances, passes unheeded.

He ascribes the pathology described by Swenson *et alii* to this form of secondary megaureter and advises the same form of treatment.

The uretero-vesical achalasia of Campbell would presumably fall into the megaureter without reflux group. Campbell (1951) emphasises the need for "trap" films taken between five and ten minutes or longer after retrograde ureterography to demonstrate the rate and extent of ureteral emptying.

Difficulty has been experienced in this series in determining into what subgroup of the various classifications certain of these patients belong, particularly as cystometry investigations were not done. The subdivision of these patients into megaureter with and without reflux is radiological, and bears on the form of treatment to be applied rather than on the aetiology or the cystoscopic findings. It was found that residual urine in the reflux group was not due in these patients to lack of contractile power of the bladder which emptied itself completely, but due to partial refilling of the bladder by the rapid discharge of the reflux urine from the dilated ureters after micturition (Figs. VII and IX). This reflux occurred as the result of uretero-vesical junction incompetence. In the group without reflux, there was no residual, false

or true, in the bladder, but delayed emptying of the ureters suggested that the uretero-vesical junction was both competent and obstructive, though not apparent to ordinary tests, to the normal passage of urine into the bladder.

SUMMARY

Excluding the obvious obstructive and neuro-pathic causes of megaureters, there remains a group of bilateral megaureters in which ordinary urinary investigation failed to disclose a mechanical obstruction. This group is divided in this study by cysto-urethrography into megaureter with, and megaureter without, vesico-ureteral reflux.

Cysto-urethrography in the reflux group demonstrated:

(1) Complete emptying of the bladder (Fig. VI) and a normal urethra and bladder neck (Figs. III and IV).

(2) Bilateral incompetence of the uretero-vesical junctions permitting reflux, though not necessarily as free up one side as up the other, in the same patient (Figs. III and IV).

(3) A filling defect in the column of iodide at the uretero-vesical junction (Fig. IV).

(4) That after evacuation of the bladder, the reflux content of the ureter was discharged quickly back into the bladder, even though unaided by gravity when the patient lay in the prone position on the table (Fig. VII).

(5) That complete evacuation of the urinary system could be brought about in the co-operative child by two or three successive acts of micturition at intervals of two minutes (Fig. X). This procedure is called "triple micturition."

(6) That after periods ranging between six and eighteen months, two patients showed progressive improvement in the dilatation, and the remainder showed no further increase in calibre or calyceal involvement.

The more patulous the ureteric orifice on cystoscopic examination the more free was the reflux, but apparently normal orifices also permitted reflux in this group. The uretero-vesical junction in this group was either completely or partially incompetent.

Treatment, apart from selective chemotherapy to sterilize the urine, was aimed at:—

(1) Removal of residual urine. This was obtained by triple micturition in the co-operative child.

(2) Protection of kidneys from back-pressure. The kidneys were shielded from the mounting pressures of the filling bladder by encouraging frequent regular "by the clock" micturition.

Over periods between one year and two and one-half years six patients were treated by this regime. Urinary infections were eliminated completely in five, and in the sixth, one short recurrence occurred (Table 1).

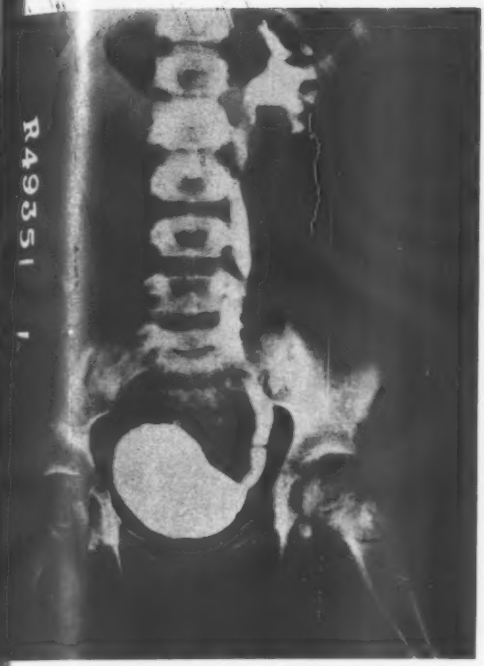
On micturition cysto-urethrography, vesico-ureteral reflux was not demonstrable in the second group, but the bladder, bladder neck and urethra were radiologically normal. There was no vesical residual urine. The ureteral orifices were normal or enlarged and presented no obstruction to catheters. The uretero-vesical junction was competent in all 6 ureters.

On examination of the ureters by intravenous pyelography and retrograde ureterography, there was change in shape suggestive of peristaltic activity.

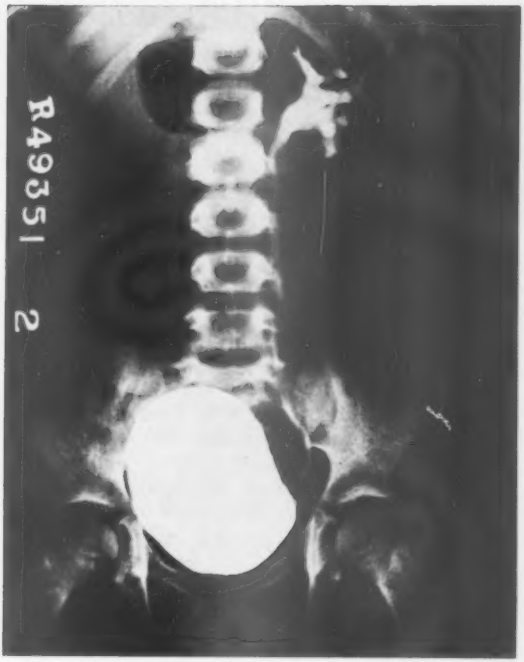
In 2 untreated children observed over periods of two to five years, there was definite progression of the ureteral, pelvic and calyceal dilatation.

Obstruction at the uretero-vesical junction was suspected by obliteration of the column of iodide at or immediately proximal to the intramural course and by considerable delay in the emptying of the ureters after retrograde injections of iodide. This delay was estimated in only 2 patients, but in both it exceeded twenty minutes.

Delay in emptying in the presence of peristalsis suggested an obstruction in the uretero-vesical junction region of the megaureter without reflux. If after conservative surgery upon the uretero-vesical junction, ureteral reflux occurs, triple micturition may help in the elimination of residual urine in the urinary tract.



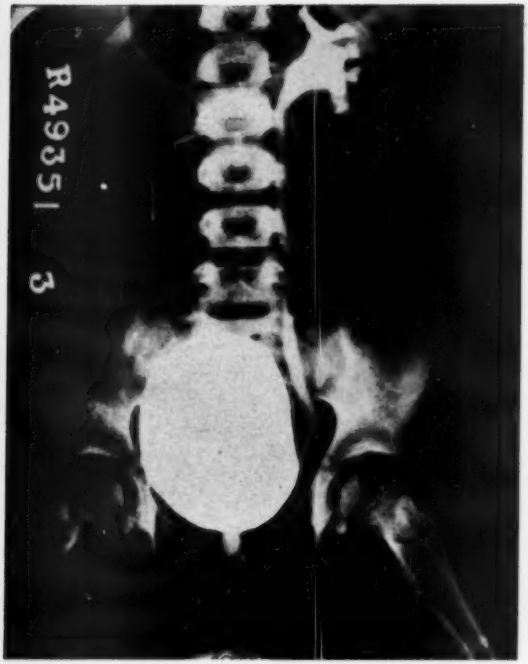
FILM No. I. Bladder containing 3 ounces 16 per cent. Uriodone showing free reflux up left ureter.



FILM No. II. Bladder containing 6 ounces and no effort made to micturate. Left ureter is emptier than in Film No. 1.

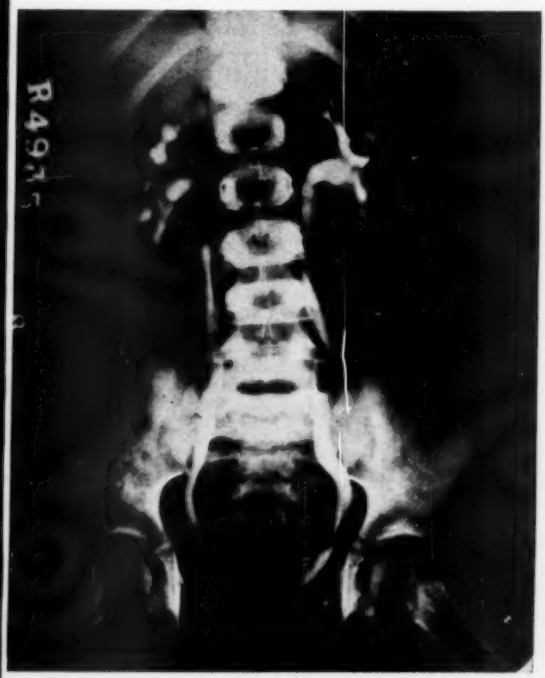
FILM No. VI. Showing air bubble in empty bladder immediately after cessation of micturition. The ureters and pelves are distended to capacity and the lower ends of the iodide columns are abruptly terminated at approximately the sites of entry into the bladder wall.

FILM No. VII. Showing distribution of iodide 30 seconds after micturition terminated as seen in Film No. VI. The ureters and pelves are partially emptied and the bladder is filling.

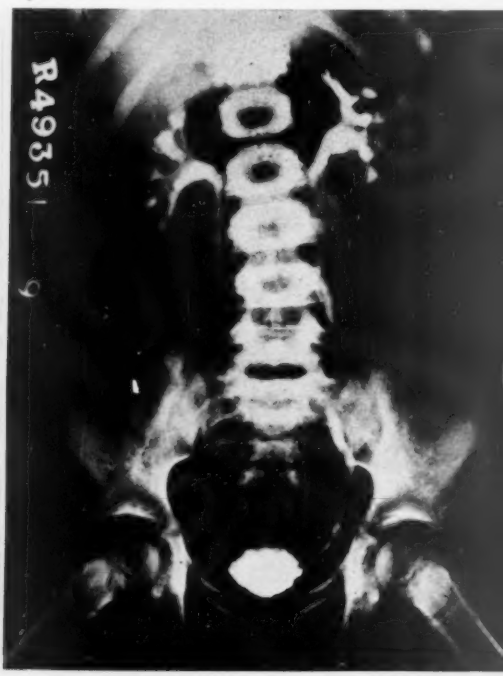


FILM No. III. Bladder contains 6 ounces and micturition begun. Left ureter as before, and urethrogram normal.

FILM No. IV. Showing bilateral ureteric reflux and norma urethrogram. The lower end of the left ureter is constricte at its intramural portion. With the sustained effort micturition the reflux distends both ureters.



FILM No. VIII. Showing distribution of iodide immediately after further few cubic centimetres passed. The bladder is again empty but iodide is still in moderate quantity in the upper urinary tract.



FILM No. IX. Three minutes after No. VI, the ureters have discharged most of their content into the bladder.

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ureters.

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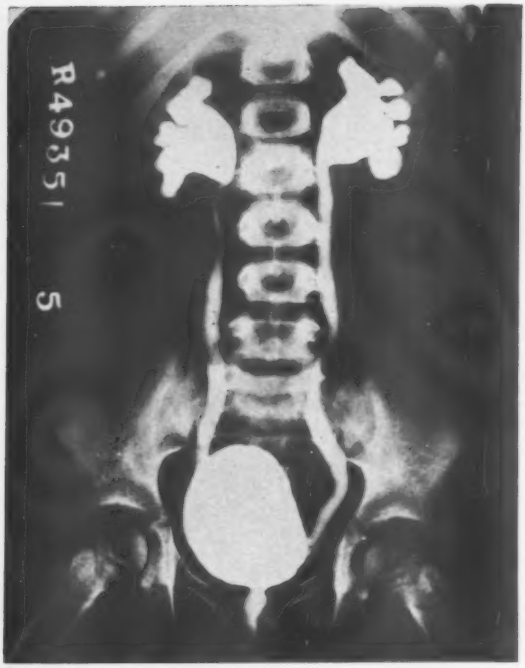
e bladder.

FILM No
pelves and

FILM N
of urine



FILM No. V. Bladder decreasing in size and ureters and pelves and calyces distended to capacity. Normal urethrogram. Normal opening of bladder neck.

FILM No. X. Three minutes after No. IX, a further 10 cc. of urine were passed and this film demonstrates that practically the whole urinary tract has been emptied.

MICTURITION CYSTO-URETHROGRAM

D.A., FEMALE AGED 7 YEARS

FIGURES I-X

Micturition cysto-urethrogram series showing ureteral reflux in D.A., female, aged 6 years 5 months. This series of pictures is representative of the findings in megaureter with vesico-ureteral reflux. See explanatory captions under the roentgenograms I-X.

Case history of D.A.—A twin. One previous attack of pyuria aged two years, and has had some enuresis and pain in the left loin since then. Well until aged 5 years 9 months. Then developed frequency, scalding, shivers, anorexia and fever with mild pain in left loin. The lower poles of both kidneys were palpable. The left was slightly tender. The bladder was not palpable. Blood pressure 120/70 mm. of mercury and blood urea 23 mgms. per 100 cc. The urine contained pus and *Escherichia coli*. In past five months practically continuous urinary infection and has lost 9 lbs. Her weight, when seen at 5 years 9 months, was 34½ lbs. and height 46 inches. Cysto-urethrography was performed at age of 5 years 9 months, and again at 6 years 5 months. Both series show same features except freer reflux up the right ureter in this, the later, investigation.

Cystoscopy revealed a winking iris-like incompetent left ureteric orifice, and the right orifice practically normal except at time of discharge of urine when a small black centre betrayed an enlarged ureteral lumen. Catheters were introduced into each ureter with ease, and after injection of 10 cc. of 12.5 per cent. sodium iodide into right and 25 cc. into the left, the ureters emptied within five minutes. The intravenous pyelogram showed good concentration of iodide in five minutes on both sides with slight clubbing and hypronephrosis at fifteen minutes on the left side. Iodide appeared in bladder at five minutes. There have been no recurrences of urinary infection during the past year since the beginning of triple micturition.

ACKNOWLEDGEMENTS

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RECURRENT CHOLEDOCHOLITHIASIS AND OBSTRUCTIVE AND PANCREATIC PROBLEMS AFTER CHOLEDOCHOTOMY*

By KENNETH W. STARR
Sydney

IN 1947 certain disquieting facts attended a review of 384 cases requiring biliary surgery. In 260 cases treated in the years 1947-1952, an attempt was made to correct these unsatisfactory sequelae.

In the first series of 384 cases (treated personally or seen in consultation) prior to 1947, choledochotomy was performed in 92 instances. The usual procedure in these cases was followed and the ampullary end of the duct was dilated to about 8 mm. and orthodox drainage was instituted by catheter or T-tube.

It was evident that tubal drainage was an imperfect solution to the problem of curing pathological states of the common bile duct because drainage difficulties, recurrence of obstructive jaundice and the persistence of pancreatic pain accounted for certain unsatisfactory results.

DIFFICULTIES IN TUBAL DRAINAGE

Firstly, tubal drainage was not always certain drainage because 5 post-operative cases of obstructive jaundice were encountered (one personal case and four seen in consultation) in which removal of the tube resulted in rapid resolution of the jaundice. Further, two cases of post-operative biliary peritonitis were seen in consultation. Both patients had indwelling tubes in the common duct. Both proved fatal.

Secondly, two cases of irremoveable T-tube were encountered, both requiring a difficult laparotomy with wide ductal exposure for their removal.

Thirdly, in one case of prolonged obstructive jaundice due to multiple ductal stones, the fluid and electrolyte loss from excessive biliary drainage was such that it contributed to a fatal issue from acute dilatation of the stomach.

Fourthly, 4 cases of stricture of the duct at the site of tubal drainage were included in this series and although such cases are not as formidable as complete severance, they are nevertheless unpleasant and of uncertain prognosis.

Fifthly, 15 cases required further laparotomy for obstructive jaundice, while in only 5 of these were stones found.

RECURRENT OBSTRUCTIVE JAUNDICE

The recurrence of obstructive jaundice in these cases presented in three ways:

1. Painful obstructive jaundice, the features being indistinguishable from those of impacted stone in the common bile duct (7 cases, 3 with stones).
2. Quiet, painless recurrence of jaundice suggesting neoplastic obstruction of the ampulla (4 cases). One of these patients presented a large number of stones in the duct at the original operation, despite their absence from the gall-bladder, and a similar state at the second operation.
3. Subclinical jaundice with occasional bouts of biliuria and a persistently high blood bilirubin (4 cases).

The findings at these operations are well known:

(a) There are stones in the duct or gall-bladder, or both, or neither.

(b) The duct may be inflamed, dilated or normal in appearance and size.

*Based on lectures delivered before the Mayo Foundation, Rochester, Minnesota, U.S.A., Guy's Hospital Medical School, London, and before the Annual Victorian State Meeting of the Royal Australasian College of Surgeons.

The accumulation of stones in the duct may even be revealed radiologically while there are no stones demonstrable in the gall-bladder, and this obvious ductal involvement leads one to the conclusion that in these cases the ductal stones are not displaced gall-bladder stones. The finding of many liver stones in one fatal case (cholangitis) supports this.

All these cases, however, manifested one common sign. The ampullary end of the common bile duct was indurated and inelastic when the ductal dilator was passed. In some, the fibrous state at the lower end had also involved portion of the head of the pancreas. In these cases ductal stones appear to be due to biliary stasis associated at first with oedema and spasm, and later with fibrous stricture at the ampullary end of the duct.

In the second series of cases, therefore, an attempt was made to perform choledochotomy without external biliary drainage and to obviate recurrence of ampullary obstruction by division of the strictured area or by short-circuiting the bile, or both. Choledochotomy was required in 66 cases (25.4 per cent.) and to these cases the principle of internal biliary drainage was applied.

That it was safe to close the common bile duct after choledochotomy and ampullary dilatation has been well known to Australian surgeons for more than fifty years as the result of the teachings of the late Sir Alexander McCormick, of Sydney. A drain is led down to the site of ductal closure for a few days, but the external loss of bile in these cases is negligible. This method was used if the sphincter was yielding and elastic (10 cases).

If, on the other hand:

(a) the sphincteric region was indurated or inelastic,

(b) this induration spread into the pancreatic head when palpated over the probe,

(c) pancreatic features were prominent in the history;

then internal biliary drainage was provided.

Three methods of internal biliary drainage were available. Because cholecyst-enterostomy was prevented by previous cholecystectomy and because calculous (or non-calculous) obstruction of the cystic duct may vitiate the short circuit (as was encountered in two cases), there remained division of the strictured area (trans-duodenal choledochotomy, sphincterotomy) or short circuit by choledocho-duodenostomy (or both combined).

Trans-duodenal choledochotomy	10 cases	Included 6 combined
Choledocho-duodenostomy	44 cases	

The latter method has been the method of choice in 105 cases till December, 1952, for varied conditions (injuries, fibrous and neoplastic stricture of the common bile duct, etc.).

There are no cases of cholangitis or calculus formation in the cul-de-sac below the short circuit following either procedure, and these operations are apparently well suited to improve internal biliary drainage. The surgeon should therefore, in my view, adopt the principle in the fashion best suited to his own experience. The operation of choledocho-duodenostomy may be rapidly and accurately performed with very little modification of routine techniques, it does not much prolong the usual operation, and it affords a shorter period of external biliary drainage, thus shortening convalescence. With small bile ducts, the trans-duodenal operation alone seems preferable for technical reasons, the short circuit being well suited to dilated ducts. The fact that none of these patients have required subsequent laparotomy for obstructive jaundice indicated either that the fistula remains open as required, or that the sphincteric induration has to some degree resolved.

The technique used is that advocated by McCarrich for stricture of the common bile duct. The anastomosis is carried out with equal facility whether the opening in the duct is longitudinal or transverse. The important points are: firstly, that the incision in the bile duct and that in the duodenum should be in juxtaposition and so placed as to avoid tension; secondly, that delicacy of mucosal apposition determines the success of

the anastomosis; thirdly, that widespread stripping of the bile duct will result in ischaemic necrosis of the duct (cholangitis obliterans), a circumstance which is not unexpected when the tenuous blood supply of the duct is studied (Shapiro and Robilliard); and fourthly, that the anastomosis must be adequately covered by peritoneum. To achieve this, the seromuscular layer of the juxtaposed duodenum is incised for a length equal to that of the duct incision. The prolapsing mucosa is withdrawn until a mucosal knuckle is prominent. This is partly removed so that the mucosal aperture will correspond in size with the ductal stoma. The tendency is to make it too large. The mucosa and seromuscularis are joined to the posterior ductal edge with one layer of interrupted 0000 silk or braided nylon. The anterior layer is joined by interrupted inverting sutures of similar material and the suture line rendered watertight with an overlying layer of peritoneum and seromuscularis. Drainage through a stab wound down to the anastomotic site is alone necessary and the tube may be rapidly withdrawn when external biliary drainage ceases.

PANCREATIC PROBLEMS

Although the recurrence of obstructive jaundice was obviated at least during the period of the review, pancreatic features were indifferently relieved. In the second series, 22 such cases presented de novo, or in association with biliary disease, or following choledochotomy. They fell into two groups. The first group (12 cases) were mainly older (fifth and sixth decades) and suffered mild symptoms which improved on the administration of pancreatic extract. The features were those of pancreatic insufficiency accompanied by occasional pain in the back and tenderness over the tail of the pancreas.

The second group (10 cases), predominantly younger, suffered from severe subacute recurrent pancreatitis. The diagnostic criteria of this condition are:

(1) severe subcostal pain resembling biliary pain but differing in three respects:
   (a) the attack is frequently more prolonged and may last 2-3 days, whereas biliary colic rarely lasts longer than one day. (It should be noted that both types of pain may terminate in obstructive jaundice).
   (b) the pain is more left sided than biliary pain and passes through to the centre of the back.
   (c) the tail of the pancreas is tender (rarely the head).

(2) the serum amylase is often, but not always, raised during the attack.

It is important to exclude penetrating duodenal ulcer as the pancreatic features may be readily confused with pancreatitis. Moreover, the symptoms are aggravated by pregnancy and even by the menses.

The severity of these symptoms was assessed thus:

(1) Laparotomy had been contemplated or performed because:
   (a) a mistaken diagnosis of perforated peptic ulcer had been made.
   (b) acute pancreatitis had supervened upon an attack of subacute pancreatitis.

(2) Large doses of sedative were required daily during the exacerbations.

(3) Remissions between the attacks had become shorter so that daily symptoms were present necessitating sedatives.

Complete resolution was rare, and the wretched state of the patients induced them to agree readily to any prospect of relief. "For the chronic disability and invalidism from severe persistent pain, any surgical procedure that promises relief is worth a trial" (Comfort, 1948).

It was considered that if fibrosis of the ampullary end of the common bile duct had been responsible for the recurrence of obstructive jaundice a similar state might account for the associated severe pancreatic symptoms, and upon this assumption an investigation was undertaken of the orifice of the pancreatic duct. A demonstrable stricture of the orifice was encountered in Case 1 (1948) and the dramatic result of

its division associated with the provision of free internal drainage of the bile led to repetition of the operation in a further 9 cases. The contrast between the subsequent state of the successful undertakings and the failures was so marked as to encourage presentation of the results and speculation upon the implications.

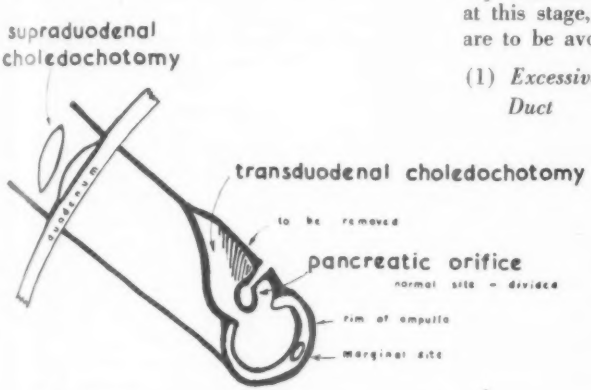

FIG. I. Operative plan for division of stricture of pancreatic orifice.

The operation for pancreatic duct stricture may be performed through either the Kocher's subcostal or paramedian incisions. The former has afforded entirely satisfactory approach for mobilization of the hepatic flexure, exposure of the bile duct and the trans-duodenal operation which is the point of maximum difficulty. In a recent case, an abdomino-thoracic incision along the 9th rib was used with a view to the right lateral retro-peritoneal duodenostomy in order to effect a more direct approach to the ampulla. The only reward for this enterprise was a duodenal fistula on the 9th day, and a discharging sinus for 9 weeks from which a small piece of celery was eventually recovered. Exploration of the abdomen is next necessary. No success in finding the ducts has attended those cases in which the diffuse fibrosis of chronic pancreatitis is present, indicating that splanchnicectomy should be undertaken if pancreatic pain and diffuse pancreatic fibrosis coexist; i.e., when the pancreas is shrunken, small and hard. The bile duct is exposed (without stripping) and opened in a longitudinal fashion, immediately above the duodenum. A malleable probe is introduced. For this purpose the 8 mm. Mayo's malleable bile duct probe is preferred. The end should be curved forward so that when it lies in the ampulla, this latter segment of the duct is lifted forward towards the anterior duodenal wall. The duodenum can then be appropriately opened in a longitudinal direction and the ampulla exposed and incised. Care should be exercised at this stage, if the following complications are to be avoided.

(1) *Excessive Opening of the Ampullary Duct*

About 1-1.5 cm. is adequate. Further opening of the duct in one of the patients (Case 3) led to brisk arterial haemorrhage from the arterial arcade. It was extremely difficult to stop, and was complicated by a retro-peritoneal haematoma resulting in an infected collection behind Morison's pouch which required drainage and prolonged convalescence.

(2) *Failure to Open the Ampulla Itself*

It is very easy to open the distal duct and leave the rim of the ampulla intact. In this event a marginal opening of the pancreatic duct may be missed. This error should be suspected if the orifice is not visible in the more common site about 5-15 mm. up the left face of the ampullary bile duct. It may be worthy of comment at this stage that the duct will be found in this site in 85 per cent. of cases, and in the marginal site in 11 per cent. The localized induration about the ampullary duct is such that in very few cases must the higher duct of Santorini be involved. Therefore, unless the ducts are readily seen in the left or marginal positions, splanchnicectomy may be required later.

(3) *Haemorrhage*

Persistent haemorrhage obscures the field and renders the location of the pancreatic orifice very difficult. A fine sucker, the use of the diathermy needle to divide the ampulla, the insertion of fine guy sutures to retract the edges and to afford a view of the ampullary bile duct have been found very helpful in this operation.

The orifice of the pancreatic duct may admit a very fine probe for a short distance (1-3 mm.) or the orifice itself may be stenosed. The blade of a fine knife is passed into the duct and the distal 1 cm. of duct divided. It is then found that a much larger probe (3 mm.) may be gently passed for 5-7 inches up the duct. It must be remembered that the duct proceeds cephalad for about 1-1.5 cm. before turning to the left into the pancreatic neck and body. There is now evident a ridge of pancreatic tissue between the opened pancreatic and common bile ducts. This should be removed so that the ducts will have unimpeded drainage into the duodenum.

The next problem will be met by each surgeon in accordance with his interpretation of the underlying pathological state. It will be noted from the case protocols that the patients appear to manifest chronic cholecystitis, hepatitis, ampullary fibrosis, diffuse pancreatic fibrosis, or localized ampullary fibrosis about the pancreatic duct orifice. If these varied fibrotic states are allied, the thesis of Womack (1944) (that cholecystitis is an obstructive and not an infective disease) may be integrated into a wider picture of pancreatico-biliary cirrhosis. The temporary incidence of severe pancreatic pain after ampullary impaction of a stone or insertion of a T-tube (see footnote) invokes a preference for short-circuiting of the bile above the area of operation until local swelling subsides. It is for this reason that internal biliary drainage by choledocho-duodenostomy has been freely employed in these cases. The failure of free internal biliary drainage alone to relieve pancreatic distress in this small series is not unique (Comfort, 1948; Gambill, 1949). The post-operative convalescence of these cases is mostly very quiet. A tube is led down to the duodenal anastomosis lest bile escape. The extent of biliary drainage depends chiefly upon the efficiency of the ampullary drainage of bile. Where the duodenum has been opened longitudinally and closed transversely through its anterior peritonealized surface, no fistulae have occurred.

Two post-operative complications were encountered. Firstly, duodenal fistula in a lateral duodenotomy. Secondly, retro-peritoneal haematoma from pancreatic haemorrhage when wide opening of the bile duct was employed.

The dramatic and continued improvement of the successful cases, the increase in appetite and weight, the freedom from pain, dyspepsia and discomfort are very impressive and obviously demand prolonged investigation.

SPECULATION

Reference may again be made to the possibility of a diffuse fibrosis in the pancreatic and biliary apparatus. The most frequent manifestation of this condition is in the gall-bladder, but it may present on occasions in the liver, pancreas or common bile duct especially at its lower end. The incidence of ampullary fibrosis appears to develop slowly in association with preceding biliary disease, or may present, in a younger group of patients, as a primary disease. In all these severe cases disease of the pancreatic duct was attended by biliary tract involvement, although this was not always evident until laparotomy was undertaken.

The similarity of the histological picture to that of rheumatoid arthritis (Littler and Ellis, 1952), the minimal histological lesions, the slowly progressive nature of the disease and its intimate relation to the entire biliary apparatus again brings forward the proposition that pancreatico-biliary fibrosis is a disorder of the hormonal metabolism. In this regard the conclusions of Womack (1944) may be worthy of reiteration. Cholecystitis is infrequent in children, is more frequent in women and people of certain habitus, and may be familial and aggravated by pregnancy. The bile affords the same bacteriological picture in obstructed and normal gall-bladders, and the experimental evidence supports the theory that cholecystitis is an obstructive disease probably associated with an action of the bile. The recent occurrence of subacute pancreatitis of severe degree in a young woman three years after choledocho-duodenostomy for divided common bile duct appears to exonerate the bile.

It may be no coincidence that the sites of maximum fibrosis at the ampulla and in the pancreas are the most fruitful areas for

One such case appears worthy of mention. The operation was successfully carried out by a colleague, T-tube drainage being employed. Death occurred on the tenth day from secondary haemorrhage (melaena) from pancreatic vessels.

carcinoma, while the remainder of the bile ducts and the gall-bladder are less frequently, and the liver rarely involved.

In 1938 Lahey suggested that we had entered the third stage of surgery for biliary stones. In the first stage, stones were removed by cholecystostomy, in the second stage removal was effected by cholecystectomy, and in the third stage stones were sought and removed from the entire biliary tree. It is not too extravagant to suggest that the fourth stage is now occupied by tackling the problems arising from associated biliary and pancreatic disease. That course could lead us to the fifth stage in which we know the cause of gall-stones.

ILLUSTRATIVE CASE HISTORIES

Case 1

H.G., male, aged 28 years. For four years had been having attacks of pancreatic pain, which resulted in acute exacerbations in 1946 and 1948, when laparotomy was required for a mistaken diagnosis of perforated peptic ulcer. At each laparotomy, acute pancreatitis was discovered. In the intervals between attacks he was sick every day, and for nine months had been incapacitated by pain requiring a daily sedative.

On 12th September, 1948, laparotomy was performed and supra-, and trans-duodenal choledochotomy was employed to expose the pancreatic orifice. The orifice refused a very fine probe until the stricture was divided, when the entire duct could be freely probed with a small dilator. A strawberry gall-bladder was found and internal biliary drainage was instituted by anastomosing the duodenum separately to the common bile duct and the gall-bladder. These free openings were considered necessary in view of the fibrotic state of the ampullary end of the common bile duct. This fibrosis extended into the head of the pancreas.

The result in this operation was dramatic and has been maintained for four years. There are no residual symptoms and no sedative is required. He has put on 21 lbs. in weight.

Case 2

S.B., female, aged 26 years. Had a cholecystectomy in 1948 for gall-stones. At this operation, a large anterior duodenal ulcer was noted. Pyloric obstruction occurred in 1949 and partial gastrectomy was performed. In 1950 a ruptured ectopic gestation required urgent operation. For six months subsequent to this operation, pancreatic pain became increasingly severe, requiring a daily sedative with morphia during the exacerbations. On 15th January, 1951, supra-, and trans-duodenal choledochotomy was employed to expose the pancreatic orifice, which was found to be strictured and could be readily passed by a large probe after division. Internal biliary drainage by choledocho-duodenostomy was used on account of the fibrosis of the ampullary segment of the bile duct. The pancreatic fibrosis was limited to the head, but hepatic fibrosis was marked.

The feeling of well-being and appetite in this patient has now been maintained for eighteen months and she has put on 28 lbs. in weight. She requires no sedative.*

Case 3

F.C., female, aged 56 years. Had a cholecystectomy in 1939, no stones being found. In 1942, on account of obstructive jaundice, the common bile duct was explored, but no stones were found. In 1947, a further exploration was undertaken for obstructive jaundice, no stones being found, and an indwelling T-tube was used to drain the common bile duct for four months. In 1949, severe pancreatic pain supervened, morphia being required weekly for two months, prior to laparotomy. On 18th May, 1949, supra-, and trans-duodenalcholedochotomy was performed, but the pancreatic duct orifice was not found in the usual position, about 1 cm. from the rim of the ampulla on the medial face of the distal end of the common bile duct. It was then found that the rim of the ampulla had not been divided properly and when this had been done a marginal orifice of the pancreatic duct immediately came into view. The stricture was situated about 2 mm. inside the orifice. It was divided, the duct was probed and internal biliary drainage provided by choledocho-duodenostomy.

The high incision in the common bile duct which failed to open the rim of the ampulla, also led to considerable haemorrhage from the arterial arcade. This was difficult to control and resulted in a retroperitoneal haematoma, which required drainage by resection of the right 12th rib. This procedure was followed by pulmonary atalectasis and abscess formation supervened, with the result that her convalescence was prolonged to five months, on account of drainage of a pyo-pneumothorax. There has been some pain at the site of the thoracotomy, but no evidence of pancreatic pain or discomfort. She has put on 70 lbs. in weight.

The interesting feature of this case was that the microscopic evidence of fibrosis was well marked about the orifice of the pancreatic duct. This is an unusual finding. The distal end of the bile duct was inelastic, with some fibrosis spreading into the pancreatic head and marked involvement of the liver.

Case 4

J.A., male, aged 35 years. Had a two years history of dyspepsia, and during the previous three months he sustained 3 attacks of severe colic, requiring morphia. These attacks were regarded as biliary colic, but they were mainly left-sided and in the back, persisted for two or three days at a

*This patient suffered recurrence of symptoms in March, 1953, while pregnant. Hysterotomy was performed with relief.

time, and were resistant to morphia. The Graham's test revealed a stone at the neck of the gall-bladder. The amylase test revealed a high level, twice normal.

It was decided, therefore, to explore the pancreatic orifice, and, with this in view, on 16th June, 1949, a right abdomino-thoracic incision along the 9th rib was employed and the duodenum opened retro-peritoneally. The exposure from this view was not better than that obtained by anterior laparotomy, and it was complicated by a duodenal fistula which prolonged his convalescence for nine weeks, until a piece of celery was eventually discharged. Strawberry gall-bladder without stones and marked fibrosis of the liver were present; the pancreatic orifice was strictured and was found in the normal medial position. Internal biliary drainage was provided by choledocho-duodenostomy.

This patient has been well for over two years, has put on 21 lbs. in weight and has no symptoms.

Case 5

R.K., male, aged 37 years. Was in hospital for treatment of pulmonary tuberculosis. After three months of pancreatic pain he developed an obstructive jaundice. After three weeks, on 15th February, 1949, laparotomy was undertaken and the obstruction was found to be due to a diffuse pancreatic fibrosis. Supra-, and trans-duodenal choledochotomy was performed, but no evidence of the pancreatic orifice could be found in the indurated pancreatic head. Choledocho-duodenostomy was employed to provide free drainage. After operation, no further jaundice occurred. The persistent pancreatic features which preceded the attack of obstructive jaundice have continued with exacerbations which require morphia. Splanchnicectomy was therefore undertaken with prompt relief for four months, followed by a recurrence of symptoms.

Case 6

J.L., male, aged 43 years. Had a cholecystectomy in 1932 for cholecystitis without stones. The fibrotic state of the liver was marked and biopsy was performed. The plasma and round cell infiltration was such that a tentative diagnosis of tertiary syphilitic hepatitis was made, and a course of iodides and bismuth administered. The symptoms remained mild until 1947, when pancreatic features commenced. The exacerbations of pain were so marked that morphia was required during the attacks and he was incapacitated. Laparotomy was undertaken on 10th March, 1949, marked fibrosis of the liver was evident and a biopsy was performed. Supra-, and trans-duodenal choledochotomy was used to expose the orifice of the pancreatic duct, the stricture was revealed, the duct probed and choledocho-duodenostomy performed. A marked fibrosis of the ampullary end of the bile duct was present and histologically demonstrable. The report on the liver biopsy was much the same as that obtained in 1932.

There has been no recurrence of pancreatic symptoms and he is able to work, although he complains of occasional right-sided discomfort with flatulence aggravated by a fatty diet. No sedatives are required and he has put on 10 lbs. in weight.

Case 7

H.M., female, aged 37 years. Had a cholecystectomy in 1947, but no stones were found. Severe pancreatic pain commenced in 1949 and laparotomy was undertaken on 12th November, 1949. Diffuse pancreatic fibrosis was discovered, the ampullary end of the common bile duct being so heavily involved that the pancreatic orifice could not be found in the indurated tissues. There was marked fibrosis of an enlarged liver. Choledocho-duodenostomy was performed. The pancreatic symptoms persisted for six months and then commenced to subside. Serum amylase levels, which were considerably raised in the attacks, following operation returned to normal, but dyspepsia continued. Choline was administered orally during the eighth to ninth post-operative months, with marked improvement, and she is now well and requires no sedatives, although a fatty diet still produces marked symptoms of flatulence.

Case 8.

H.D., male, aged 63 years. Had a cholecystectomy for stones in 1939. Flatulence and dyspepsia continued after the operation and pancreatic features appeared in 1949. These became severe during the six months preceding operation, the exacerbations requiring morphia. On 18th August, 1950, laparotomy was performed and supra-, and trans-duodenal choledochotomy enabled a stricture of the pancreatic duct orifice, situated in the normal position, to be divided and the duct probed. There was marked fibrosis of the ampullary region of the common bile duct and pancreatic head, and choledocho-duodenostomy was performed. The histological picture demonstrated the fibrosis, an unusual finding. This patient has been well since operation and requires no sedatives. Dietary indiscretion, especially with fats, can, however, produce severe dyspepsia.

Case 9

J. McM., male, aged 53 years. Has had symptoms of pancreatic insufficiency with fatty diarrhoea for twenty years. He has taken large amounts of pancreatic extract under medical advice during the last decade, without relief. Severe pancreatic pain commenced fifteen months previously. The exacerbations occurred each four to six weeks and required morphia. They were preceded by attacks of faintness, flushing and fullness, and tachycardia, about twenty minutes after commencing his meal. He was forced to lie down until the attacks passed off and although no operation had been performed on his stomach, the history of these incidents had many of the features of the "dumping" syndrome.

In January, 1951, he had a very severe attack of pain, and laparotomy was performed as an urgency, with the diagnosis of peri-gastric abscess following a perforated peptic ulcer. Pancreatitis was found and the abdomen was closed.

On 15th July, 1951, laparotomy was therefore undertaken, a strawberry gall-bladder was discovered, with induration, about the lower end of the common bile duct and pancreatic head. It was therefore decided to explore the pancreatic orifice; supra-, and trans-duodenal choledochotomy was employed.

Stricture was demonstrated at the orifice of the duct which was found in the normal position. Choledocho-duodenostomy was performed for internal biliary drainage. This patient has been well since operation, no sedatives are required. He finds that he must be careful of his diet, chiefly on account of flatulence and dyspepsia. The features of the "dumping" syndrome have disappeared, he has put on 10 lbs. in weight.

During the years 1937-1941, he had had four operations for pansinusitis (including the frontal sinuses). He is bothered by headaches and post-nasal discharge. After consultation with his oto-rhino-laryngolosist palliative treatment has been instituted in an attempt to improve flatulence which may be due to a secondary gastritis.

ACKNOWLEDGEMENTS

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ADDENDUM

As at 30th June, 1953, the satisfactory results in this series have maintained their progress (Cases 1, 3, 4, 6, 8). Case 2 continues to complain of occasional pain, but refuses splanchnic injection and is considered by colleagues to be a psycho-neurotic. Case 7 remains well on choline therapy and Case 9 is to be subjected to a course of irradiation for his pansinusitis. Five new cases can now be added, four of which are now symptomless for periods of less than eighteen months. Case 15 unexpectedly perished of an unknown cause on the sixth post-operative day. She developed sudden and dramatic hypotension and oliguria without warning on the late second post-operative day which responded to blood transfusion and Cortisone for twenty-four hours, but not to transfusion alone. She was apparently well and ambulatory when she died. Post-mortem was refused. It is presumed that death was due to pulmonary embolism.

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THE SIGNIFICANCE OF NIPPLE DISCHARGE

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Introduction

DISCHARGE from the nipple is a common presenting symptom which is a source of great alarm to the patient. Its significance in relation to the nature of pathological change in the breast is not clear cut and its management with respect to extent of surgical interference varies in the hands of different surgeons, as a direct reflection on the opinion they hold about the underlying pathological condition.

There have been numerous reports on the incidence of carcinoma in cases of papillary growths in the ducts. Warren (1905) recognized the benign character of "papillary cyst-adenoma" and advocated local excision. Greenough and Simmons (1907) reported 17 benign papillomata in 20 cases. Lewis (1916) found that a serous or blood-stained discharge from the nipple was indicative of benign papilloma more commonly than carcinoma and that in cases where no tumour could be palpated, pressure on the appropriate sector of the breast reproduced the discharge thus localizing the area of surgical dissection.

Other authors (Miller and Lewis, 1923; Judd, 1917) found a high incidence of carcinoma in their series (up to 68 per cent.). In Judd's series of 100 cases, he found a close association between the presence of a tumour in a case of discharge from the nipple and the finding of a carcinoma, so that he advocated mastectomy for all cases with a lump and conservative treatment for the others. Bloodgood (1922, 1932) considered the intra-duct papillomata to be benign lesions, not pre-cancerous. He found carcinoma of the breast to be associated with discharge in only one per cent. of cases.

Adair (1930) published a series of 108 cases of blood-stained nipple discharge in which he found that 47.2 per cent. of cases had a carconima and 52.8 per cent. benign lesions and felt that a papilloma might develop into a papillary adenocarcinoma. Wakeley (1947) deplored the frequency of performing simple mastectomy for blood-stained discharge: he found that 82 cases, out of a total 119, had benign conditions in the breast.

Adair (1949) reported 416 cases presenting with sero-sanguinous discharge operated on since 1941: all cases were treated by local sector excision, and subjected to pathological examination, but even if the report described an active papilloma, simple mastectomy was not performed. To the time of the report, no case had developed evidence of carcinoma in the breast so that Adair asserts that papillomatosis is a benign condition. He considers that when a carcinoma is found in the breast in association with bleeding from the nipple, carcinoma does not develop from a previous benign papilloma.

It is obvious that over the last fifty years there has been some variation in the opinions held about the significance of nipple discharge.

The general trend is to regard it as being associated most commonly with a benign intra-duct papilloma for which simple excision suffices. However, in all cases a pathological report of the excised tissue must be obtained and further radical surgery guided by the findings.

Material

It is proposed to review cases of nipple discharge operated on at the Royal Melbourne Hospital over a period of five years, 1947 to 1951 inclusive.

Over this period, operations on the breast, other than radical mastectomy, were carried out 139 times. Of these, 73 were performed for lobular hyperplasia, including fibro-adenoma; 32 for discharge from the nipple; 8 for fat necrosis; 15 for inflammatory conditions of the breast and 14 for carcinoma in old women.

CLINICAL FINDINGS

Duct papilloma was the pre-operative diagnosis recorded in most cases associated with discharge from the nipple. (The cases associated with obvious Paget's disease are not included.)

The discharge varied: it was serous yellow in 5 cases. In others it was dark brown and viscous; in some cases these two varieties were found in the same patient at different times, with intervals of weeks to months; commonly in this group the serous type preceded the brown viscous type; finally in some, discharge was yellow serous but a few drops of fresh blood could be expressed by forcible pressure. All these cases total 27.

Whenever any of these types of discharge were present, irrespective of the associated findings in the breast, duct papilloma was the recorded presumptive diagnosis. Since it is well-known that in some cases no duct papilloma can be found in the resected breast or in that resected sector which is thought to bear the papilloma in its ducts, it was decided to investigate the relationship, if any, of clinical signs to the pathological findings and the place of surgery in the treatment of the condition.

LOCALIZATION OF DISCHARGE

It was interesting to note that in every one of the 32 cases of nipple discharge, pressure on a particular sector of the breast, just near the areola, reproduced the discharge, except that in a few cases fresh blood could be expressed which had not occurred spontaneously. Thus in no case was the discharge unlocalized, although, in a number of cases, no lump, to which the aetiology of the discharge might be ascribed, was to be found on careful examination of the breast.

RELATION OF CLINICAL TO PATHOLOGICAL FINDINGS

Clinically, six groups were readily identified.

Group 1a: isolated lump associated with discharge with pressure on the lump;

Group 1b: isolated lump, as under 1a, associated with diffuse lobular hyperplasia in the breast;

Group 2: cyst situated near the nipple;

Group 3: sector thickening;

Group 4: nipple retraction;

Group 5: diffuse lobular hyperplasia;

Group 6: no apparent change detectable in the breast.

Groups 1a and 1b: Isolated Lump

In these cases the lump was about 5 mm. in diameter and situated under the areola with surrounding breast skin. The lump was firm, elastic with no attachment to overlying skin and not thought to be cystic.

TABLE 1A

Table showing cases of nipple discharge associated with a lump in the breast.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
1	61	blood	2 weeks	lump excision	simple cyst
2	50	dark	2 months	simple mastectomy	duct papilloma; lobular hyperplasia
3	47	serous dark	1 month 2 weeks	simple mastectomy	hyperplasia of duct epithelium
4	32	dark	5 months	lump excision	duct papilloma; lobular hyperplasia
5	42	green dark	4 years 3 months	nipple excision	duct papilloma in nipple

TABLE 1B

Table showing cases of nipple discharge associated with a lump in the breast with associated lobular hyperplasia.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
6	48	yellow dark	5 months 2 months	radical mastectomy	duct papilloma
7	47	yellow	7 years	simple mastectomy	duct papilloma
8	67	dark	3 months	simple mastectomy	cyst with hyperplasia of lining epithelium

In these groups, the lump was found to be a well-formed papilloma in a duct in 5 of 8 cases; in 2 there were microscopic papillary projections, and in one a simple cyst.

The long duration of the discharge in 2 cases, four and seven years respectively is of special interest.

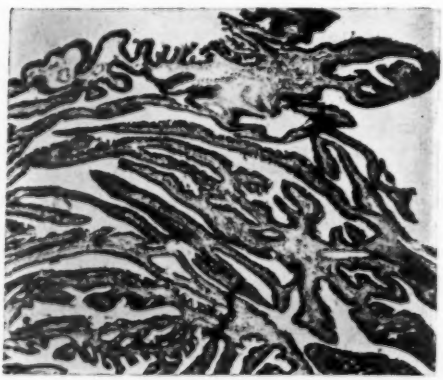

FIG. 1. Photomicrograph of a section of large duct of the breast showing large anastomosing papillary projections with fine connective tissue cores and columnar epithelial lining. (x 80)

Intra-duct papillomata are the result of a simple proliferation of the duct epithelium producing projections into the lumen of the duct. The projections consist of simple columnar or cuboidal cells supported on vascular connective stalks. These are very thin and undergo multiple branching with apparent anastomosing of the tips of the same or adjacent papilloma. The cells lining the duct are columnar and regular in staining property, size and shape. There is no invasion of the stalk of the papilloma by the proliferated cells.

Group 2: Cyst near Nipple

This group is differentiated from Group 1 because the lump was much larger and was tense and cystic.

In both these cases there was associated lobular hyperplasia in the surrounding breast tissue and the cysts were considered to be part of this process. Only one case showed a duct papilloma.

TABLE 2

Table showing cases of nipple discharge associated with a cyst in the breast.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
9	68	yellow dark	3 months 1 week	simple mastectomy	cyst 2 cm. diam. with papilloma
10	37	dark	3 months	simple mastectomy	hyperplasia of duct epithelium

TABLE 3.

Table showing cases of nipple discharge associated with thickening of a sector in the breast.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
11	63	dark	6 months	simple mastectomy	duct dilatation; papillary projections of duct epithelium
12	61	dark	1 month	simple mastectomy	duct dilatation
13	34	dark	1 month	sector excision	lobular hyperplasia
14	38	dark	1½ years	sector excision	normal tissue

Group 3: Sector Thickening

This consisted of a thickening felt in the breast so as to outline a lobule in a radial fashion without diffuse lobular hyperplasia changes and with discharge from the nipple produced on pressure over the area of thickening.

In this group of 4 cases, one showed papillary projections of the duct epithelium. In 2 there was duct dilatation. This gives an interesting macroscopic appearance; those ducts of the breast, pressure on which produced the discharge, are seen to be filled with dark viscous material but careful inspection fails to reveal a macroscopic papilloma. Microscopically small papillary projections may be seen arising in the epithelium lining these ducts, but in some cases even this is absent and it is to be presumed that epithelial hyperplasia has occurred in such a fashion that the new cells arrange themselves side by side rather than shift on a stalk toward the lumen of the duct: thus the circumference and the diameter of the duct is increased. Such duct dilatation without papillary projection is considered to be a variant of hyperplasia of the duct epithelium for purposes of classification.

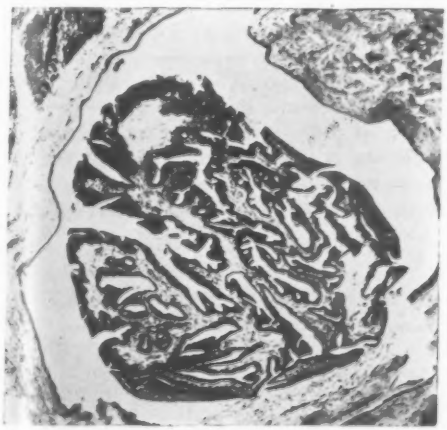

FIG. II. Photomicrograph of section of breast tissue showing medium-sized papilloma projecting into a dilated duct lined by columnar epithelium. (x 80)

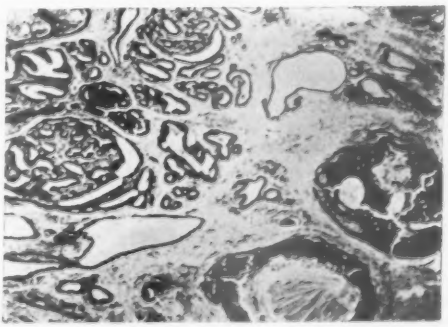

FIG. III. Photomicrograph of section of breast tissue showing numerous small dilated ducts. The ducts in upper left quadrant show typical intraduct papillary formation whilst those in the lower right quadrant show proliferation by increase in the layers of epithelium without stromal support. (x 80)

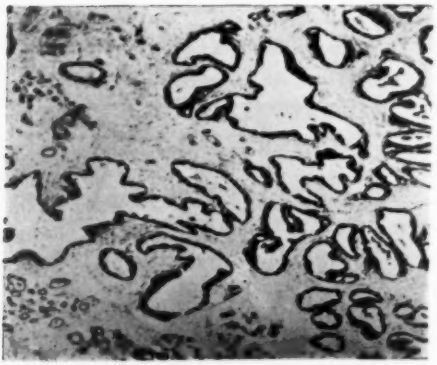

FIG. IV. Photomicrograph of a section of breast tissue showing numerous small dilated ducts without significant proliferation of epithelium into the lumen. (x 80)

FIG. V. Photomicrograph of a section of breast tissue showing a large dilated duct in an area of lobular hyperplasia. In this duct some papillary projections are seen on the right. (x 80)

Group 4: Nipple Retraction

This group is interesting in view of the common clinical association of retraction with carcinoma of the breast.

This case exemplifies the occurrence of the duct dilatation type of hyperplasia associated with infection and peri-ductal fibrosis leading to retraction of the nipple.

Group 5: Lobular Hyperplasia

In this group of 8 cases where no discrete lump could be felt that might be incriminated as the source of the discharge, a macroscopic papilloma was found in one case and microscopic papillary projections were found in 4 cases; one showed duct dilatation.

Group 6: No Clinically Apparent Changes in the Breast

In this group of 9 cases there was one well-formed papilloma. Epithelial hyperplasia was evident in 6 cases.

DISCUSSION

The data shown in Table 7 have been arranged in diagrammatic fashion in Fig. VI.

Analysis of the data shows that discharge associated with a discrete lump near the nipple affords the greatest incidence of macroscopic papillomata (two-thirds of the cases). When no discrete lump is present the incidence of papilloma falls rapidly: it occurred in one of 2 cases of cyst near the nipple and in one-eighth to one-quarter of the cases in the groups where no lump is detected clinically. Where no discrete papilloma was detected there was a varying incidence of hyperplasia of duct epithelium, either as microscopic papillary projections or as duct dilatation, as high as two-thirds in the group of lobular hyperplasia cases.

TABLE 4

Table showing case of nipple discharge associated with retraction of the nipple.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
15	58	yellow white	1 week	sector excision	dilated ducts; chronic peri-ductal inflammation

TABLE 5

Table showing cases of nipple discharge associated with lobular hyperplasia in the breast.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
16	44	dark	9 months	simple mastectomy	papillary projections of duct epithelium; lobular hyperplasia
17	45	dark	4 months	sector excision	papillary projections of duct epithelium
18	48	yellow blood	3 years 3 weeks	simple mastectomy	papillary projections of duct epithelium; lobular hyperplasia
19	46	dark	1½ months	simple mastectomy	lobular hyperplasia
20	42	dark	3 months	simple mastectomy	lobular hyperplasia
21	44	yellow	2 months	simple mastectomy	duct dilatation
22	58	dark	1 month	simple mastectomy	hyperplasia of duct epithelium
23	41	yellow dark	6 months 1½ months	simple mastectomy	duct papilloma; lobular hyperplasia

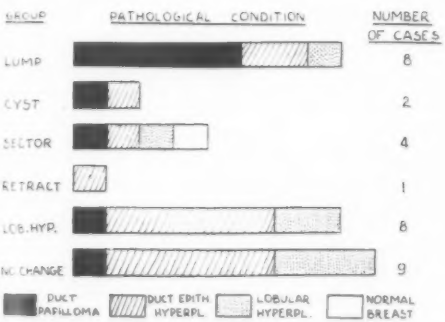

FIG. VI. Diagram showing the relation of pathological findings to the clinical signs in each group of nipple discharge.

One can therefore conclude that when there is nipple discharge there is microscopic evidence of duct epithelial hyperplasia in a high proportion of cases, irrespective of the clinical findings, even if negative, in the related breast. If a discrete lump be found, the chances of finding a macroscopic papilloma are sufficiently high (about two-thirds) to make the pre-operative diagnosis of duct papilloma likely, although absence of it in the resected specimen would be no cause for surprise.

Similarly, one may find a duct papilloma in cases with no discrete lump but the rate of occurrence is lower: about one-fifth.

When subsequent examination fails to reveal any abnormality other than lobular hyperplasia, one is at a loss to explain with certainty the cause of a dark discharge from the nipple, but this is a frequent observation and it occurs in about one-fifth of all cases.

There appears to be no definite relation of the occurrence of a definite papilloma to age incidence. The ages varied in the whole series from 26 to 68 years. The ages in the patients, in whom a papilloma was demonstrated, were found to vary from 32 to 68 years.

The relation of type of discharge to the occurrence of a macroscopic papilloma is also of no significance.

TABLE 6.

Table showing cases of nipple discharge associated with no clinical change in the breast.

Case	Age in Years	Type of Discharge	Duration of Discharge	Operation	Pathological Findings
24	45	dark	6 months	simple mastectomy	duct papilloma; lobular hyperplasia
25	62	dark	6 months	sector excision	duct dilatation
26	65	dark	2½ months	simple mastectomy	lobular hyperplasia
27	60	dark	3 months	simple mastectomy	hyperplasia of duct epithelium
28	57	dark	3 months	sector excision	hyperplasia of duct epithelium
29	37	dark	4 months	simple mastectomy	lobular hyperplasia
30	34	dark	1 month	sector excision	duct dilatation; hyperplasia epithelium
31	26	dark	3 months	sector excision	duct dilatation
32	57	dark	2 months	simple mastectomy	lobular hyperplasia

TABLE 7.

Table showing the frequency of findings in the various pathological groups (Cf. Fig. VI).

Group		Number of Cases in Each Group	Macroscopic Papilloma	Microscopic Hyperplasia; Epithelial Hyperplasia Duct Dilatation	Lobular Hyperplasia	No Change
			Number	Number	Number	Number
1	Lump	8	5	2	1	
2	Cyst	2	1	1		
3	Sector	4	1	1	1	1
4	Retract	1		1		
5	Lobular Hyperplasia	8	1	5	2	
6	No Change	9	1	5	3	

Of the total of 32 cases, 23 had dark discharges, 4 had serous discharges, and 5 had the serous followed by the dark type.

Of the total of 9 papillomata found, 3 had dark discharge, 2 had serous discharge and 4 had the serous followed by dark type.

The differentiation between oxidase positive and oxidase negative discharges as suggested by Atkins (1950) was not available in this series.

The relation between the duration of the discharge and the finding of a papilloma was suggestive: if the duration was longer than nine months a duct papilloma or well-formed multiple papillary projections were found (Cases 5, 7, 16, 18, 23). Case 14 was an exception, as, despite the occurrence of discharge for one and a half years, no abnormality could be found in the resected tissue.

THE CHOICE OF OPERATION

The occurrence of bleeding from the nipple is frequently regarded as a sign of sinister significance. Although there is wide recognition that carcinoma of the breast is infrequently associated with discharge from the nipple, the fear of missing an early duct carcinoma has influenced many surgeons in performing operations on the breast which must be considered to be very radical when related to the pathological findings in the tissue resected.

Furthermore, in a series such as this, where a number of different surgeons was confronted with a similar problem, one finds that there is lack of unanimity in the form of operation carried out.

Fig. VII exemplifies the high rate of simple mastectomy in the various clinical groups previously outlined. Where this has been performed, there has been no record of an initial attempt at locating the duct system responsible for the discharge.

One may surmise that a mutilating operation was thought to be warranted by the assumption, either that it is not possible to dissect out adequately the offending duct system or that any serous or dark discharge from the nipple is indicative of a pre-cancerous condition in the epithelium of the ducts.

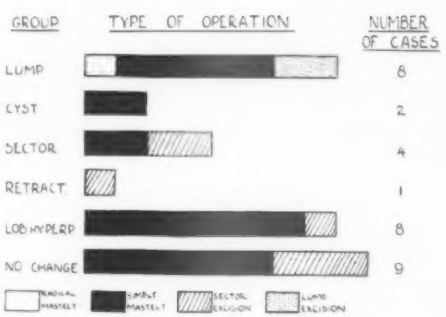

FIG. VII. Diagram showing the relation of type of operation to clinical signs in each group of nipple discharge.

The former assumption cannot apply since many successful dissections have been carried out, even in the present series.

The second assumption is not borne out by the available follow-up in the present series. The earliest cases were operated on seven years ago and the latest two years ago: in no case is there any record of development of carcinoma of the breast. Furthermore, the cases that had discharge for the longest duration (nine months to seven years) showed non-malignant types of epithelial hyperplasia. There is no doubt, however, that hyperplasia was present: of the total of 32 cases, duct papillomata were found in 9, microscopic proliferation in 15; in the remaining 8 cases, 7 had lobular hyperplasia only and one had no change.

On the available evidence, the lesions are therefore to be considered benign. Yet it cannot be denied that any woman with a serous or blood-stained discharge from the nipple has a good deal of anxiety about its significance even despite medical reassurance.

It is therefore urged that when operation is performed, it should be the least mutilating — compatible with removal of the hyperplastic epithelium — and since duct papillomata are difficult to visualize at operation, sector excision is advised.

In these cases the appearance of dilated ducts filled with dark brown material readily leads the surgeon to removal of the correct sector. As in a few cases, the ducts may be empty at the time of operation or be filled with yellow serous discharge only, either of

which possibilities make the finding of the responsible ducts difficult, it is advisable to ascertain the exact site of the discharge, by exerting pressure over the appropriate sector of the breast, just prior to operation. As mentioned earlier, in this series, this sign could invariably be elicited.

CONCLUSION

Thirty-two cases of nipple discharge are reviewed. The ages ranged from 26 to 67 years. Nine cases showed a duct papilloma. Fifteen cases showed microscopic evidence of hyperplasia of duct epithelium. Seven cases showed lobular hyperplasia and one case showed no demonstrable change in the resected tissue.

There is good correlation between the presence of a lump demonstrated clinically and the finding of a papilloma.

The cases reviewed were taken from a number of operations on the breast other than radical mastectomy over a period of five years; therefore no comparison can be made in this series between the incidence of malignant and benign breast neoplasms presenting with discharge from the nipple.

It will be evident from the literature that the condition may be considered benign even when the discharge has been present for a number of years.

The use of simple mastectomy is deprecated as usually there are sufficient localizing signs to indicate which sector of the breast is the source of the discharge.

ACKNOWLEDGEMENTS

I wish to thank the Honorary Medical Staff of the Royal Melbourne Hospital for permission to use their records. This work has been carried out whilst holding a grant from the Anti-Cancer Council of Victoria.

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THE TERMINAL PORTION OF THE COMMON BILE DUCT AND OF THE PANCREATIC DUCT OF WIRSUNG

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THE terminal parts of the common bile duct and pancreatic duct of Wirsung, where they pass obliquely through the wall of the duodenum, have been assigned important roles in non-malignant pathological disturbances of biliary and pancreatic functions. In this part of their course the ducts have become narrowed to a maximum degree, although this is not apparent until they have been sectioned because of the increased thickness of the walls. It is known that the passage of gall-stones is hindered or prevented by this portion of the common bile duct and that stones impacted here may interfere with pancreatic excretion because of the proximity of the ducts. In many clinics it is believed that functional disorders of the muscular sphincter of Oddi are the cause of symptoms whilst in recent years it has been claimed that fibrotic stenosis, the sequel of stones and sounds but sometimes of idiopathic origin, may involve one or both ducts.

The literature concerning the surgical anatomy of this portion of the common bile duct and of the pancreatic duct of Wirsung has been reviewed, but there are few available references of practical value to the surgeon or to the radiologist. Most studies have been concerned with the presence or absence of an ampulla and the composition of the sphincter of Oddi. The object of the present work was to obtain information about aspects, neglected by some previous investigators, which are important to pathologist, radiologist, and surgeon.

The area is particularly difficult to study accurately during the course of operative surgery. As the common bile duct and pancreatic duct approach the duodenum they are embedded in the posterior aspect of the pancreas, whilst the duodenal papilla is concealed by the transverse folds of the duodenum and is not easily visualized after duodenotomy.

The intraduodenal part of the common bile duct can be visualized radiologically by means of cholangiography, but the interpretation of the films is difficult, and little help has been obtained from them in elucidating normal anatomical relations.

Despite uncertainty in the pathology, and lack of accurate anatomical information, the scope of surgery in this region has gradually widened. The passage of sounds along the common bile duct into the duodenum following supraduodenal choledochotomy, and transduodenal extraction of stones impacted in the ampulla of Vater have been recognized manoeuvres in the surgery of choledocholithiasis. But operations designed to relieve suspected stenosis of the ampullary region, whether caused by fibrosis or by muscular spasm, and whether involving the common bile duct, the pancreatic duct or both are being advocated with an increasing frequency.

Mode of Investigation

Forty specimens obtained at autopsy were dissected. The first, second, and third parts of the duodenum were removed *en bloc* with the pancreas and bile duct. The first and third parts of the duodenum were ligatured with string, and 10 per cent. formalin was run into the specimen through the common bile duct until the duodenum was distended. It was found unnecessary to ligature the body of the pancreas or the common bile duct because no leakage occurred despite a very tense duodenum; presumably the oblique passage of the common bile duct exerts an effective sphincteric mechanism preventing reflux. The specimens were kept in formalin until hardened. The duodenal wall was then cut away to expose the duodenal papilla. The common bile duct and the pancreatic duct of Wirsung were sought on the dorsal surface of the pancreas and were dissected to the duodenal wall. Both ducts were opened in their pan-

creatic and intramural parts and in thirty of the specimens certain measurements were made. It is realized that measurement of formalin-hardened specimens to the nearest millimetre is open to the objection that the specimen undergoes shrinkage and therefore results are not strictly applicable to elastic living tissues.

OBSERVATIONS

1. *Extramural course of the bile and pancreatic ducts*

In 4 of the 30 specimens, the common bile duct coursed distally in immediate contact with the second part of the duodenum; in 7 specimens the duct was separated from the duodenum by pancreatic tissue for the whole of its length; in the remaining 19 cases the common duct was separated by pancreatic tissue from the duodenum except for a short distance prior to piercing the wall of the duodenum; this intimate relation to the duodenum extended for a length varying from 8 mm. to 20 mm. (average 12.6 mm.).

The pancreatic duct of Wirsung was demonstrable in each specimen, and in each it became enveloped in the same adventitial sheath as the common bile duct just outside the duodenum, to form a low smooth elevation. This apparent fusion of the two ducts always occurred just proximal to the duodenal wall at a distance in this series of 2 mm. to 10 mm. (average 5.3 mm.). The conjoined ducts were of firm consistency even before becoming hardened by formalin. A duct of Santorini was found in 27 of the 30 cases.

When the ducts were opened, it was found that at the junction of the pancreatic and bile ducts the lumen of both ducts narrowed abruptly. The diameter of the common bile duct just above this transition varied from 4 mm. to 14 mm. In 24 specimens the diameter varied from 6 mm. to 10 mm., with an average for the 30 dissections in the series of 8.5 mm.

The diameter of the pancreatic duct varied from 2 mm. to 7 mm. In 28 specimens, the diameter was between 2 mm. and 5 mm. The average diameter for the 30 specimens was 3.8 mm.

At the point at which the common duct narrowed abruptly the smaller orifice was situated eccentrically in 18 of the 30 specimens. In two instances the smaller orifice was found on the duodenal side of the common duct, and in the remaining 16 it was on the pancreatic side.

2. *Intramural course of the bile and pancreatic ducts*

The combined ducts enclosed in a common adventitial sheath formed a short indurated cord. The distance between the site of perforation of the longitudinal muscular coat and the middle of the orifice of the major duodenal papilla varied from 6 mm. to 25 mm.; in 21 specimens the length was between 10 and 15 mm.; in 2 instances the length was less than 10 mm., that is, 6 mm. and 9 mm. respectively, whilst in 5 specimens the length was over 20 mm. The diameter of this segment varied from 3 mm. to 10 mm. (average, 6.3 mm.).

On section the combined ducts both appeared as slit-like passages with dense white walls. The two ducts were separated by a septum, which was attached by a wide base to the adventitial sheath at the junction of the two ducts and gradually tapered towards the distal end. This septum was a constant feature in these dissections, and its length was directly proportional to the length of the intramural segment of the ducts. The bile duct was always situated on the lateral aspect of the pancreatic duct. In 8 specimens the septum could be seen protruding through the papillary orifice. The septum was not always complete in its distal free end; its length varied from 2 mm. to 17 mm. (average, 9.2 mm.).

In 11 instances the septum completely separated the two ducts so that there was no ampulla; the orifice of the bile duct was above that of the pancreatic duct, and both were situated within the apex of the papilla; there was no instance of the two orifices possessing separate papillae. In 7 other specimens the ampulla was but 1 to 2 mm. long. In only 6 specimens was the common channel longer than 5 mm.; the longest ampulla was 12 mm. The average length of the ampulla in the 19 specimens in which it was present was 3.8 mm.

3. *The duodenal papillae*

The major duodenal papilla was present in every case, although in 12 specimens it was not particularly prominent; in 4 instances it

was very large. In many cases it opened at the proximal end of a thin longitudinal fold of mucous membrane which varied from 1 cm. to 3 cm. in length. In most instances the intramural portion of the two ducts was apparent on the mucosal surface as a broader, ill-defined elevation.

The duct of Santorini opened on the apex of a small firm papilla, referred to as the "minor papilla". It was seen in all but three of the specimens; it was always ventral in relation to the major papilla, and was always proximal, at a distance varying from 4 mm. to 40 mm.

A single diverticulum of the duodenum was found in 7 of the 30 specimens, in close relation to the major papilla. In 5 instances, the diverticulum was on the dorsal aspect of the junction of the two ducts, and in 2 cases it was ventral. In 4 of these 7 specimens the diverticulum caused a distortion of the path pursued by the combined ducts; in 1 case the diverticulum separated the two ducts; and in the remaining 2 specimens the ducts were not disturbed by the proximity of the diverticulum. In one instance the major papilla was situated in the fundus of the diverticulum, and in a second the papilla was just within the mouth of the diverticulum. The average width of the diverticulum was 10 mm., and the depth 15 mm., the largest being 17 mm. by 23 mm.

In one case there was a shallow diverticulum in relation to the duct of Santorini, and in a further case multiple small diverticula studded the surface of the duodenum.

DISCUSSION

As the common bile duct passes distally on the dorsal aspect of the pancreas, it is covered as a rule by a thin layer of pancreatic tissue. The duct usually approaches the second part of the duodenum obliquely, but in the last 10 to 15 mm. of its pancreatic course comes into intimate relation with the wall of the duodenum. The duct may, however, remain in close contact with the duodenal wall for the whole of its pancreatic course (Fig. I). Immediately proximal to its junction with the pancreatic duct, and where it narrows abruptly from an average diameter of 8.5 mm. it tends to form a shallow pouch situated usually on the duodenal aspect of the duct (Fig. II). Baldwin (1911) is one of the few to draw attention to this sharp narrowing of the lumen which can only be appreciated after the ducts have been opened. That it is no artefact produced in preparing the specimens is shown by the presence of a similar narrowing in cholangiograms, operative or post-operative (Fig. III).

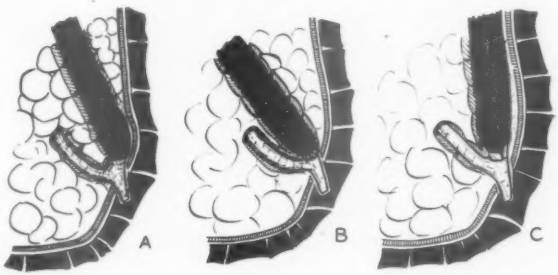

FIG. I. The relation of the pancreatic portion of the common bile duct to the duodenum.

A. In 19 cases the duct was in intimate relation to the duodenum for 10-15 mm.

B. In 7 cases, the duct was separated by pancreatic tissue for the whole of its length.

C. In 4 cases the common bile duct was in contact with the duodenum in the whole of its pancreatic course.

The pancreatic duct of Wirsung also lies close to the dorsal surface of the pancreas and like the common bile duct it is covered on its dorsal surface by a layer of pancreatic tissue which is a little thicker than that covering the common bile duct. The pancreatic duct of Wirsung runs roughly parallel to the common bile duct. When the pancreatic duct is opened and followed towards the duodenum, the same sudden narrowing is apparent in the lumen as is observed in the common bile duct, but it is perhaps less obvious because the average diameter of this duct is only 3.8 mm. So narrow was the orifice leading to the intramural portion of the duct that it frequently proved difficult during this investigation to insert even the finest probe (Figs. III, VI and VII).

The two ducts unite before the combined intramural course begins (Fig. IV). At this

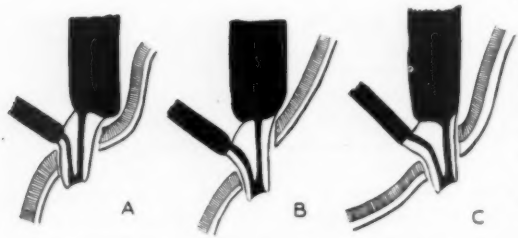

FIG. II. The common bile duct narrows abruptly. The orifice leading into the intramural portion may be eccentrically situated with the formation of a shallow pouch.

A. In 16 cases the pouch was on the duodenal side.

B. In 12 cases the orifice was centrally situated and no pouch existed.

C. In 2 cases the pouch was on the pancreatic side.

junction the ducts are bound together by dense tissue to form a smooth elevation projecting on the external surface of the duodenal wall (Fig. V). But the two channels do not become contiguous at this point as is so often believed. They are separated by a fibrous partition which is V-shaped. The apex of the V extends a variable distance and may completely seperate the two ducts. It often projects into the duodenum for 1 or 2 mm. beyond the mouth of the major duodenal papilla. The base of the V-shaped septum is attached to the adventitial tissue which binds the two ducts together where they join just outside the duodenum (Fig. VI).

The length of the intramural portion of the combined ducts varies from 5 mm. to 25 mm. with an average length in this series of 15 mm., which corresponds with the length given by Poirier and Charpy (1912) and others. This intramural segment, in the fresh specimen, has a firm consistency with dense white walls on section, and may be up to 10 mm. in diameter.

In no specimen dissected in this series was a pancreatic duct of Wirsung found entering the duodenum at a site other than the major papilla, although Baldwin (1911) observed that in one of his 90 specimens, and Mann and Giordano (1923) and Millbourn (1950) in 4 per cent. and 9 per cent. of their respective series that the duct of Santorini was the sole apparent excretory channel of the pancreas.

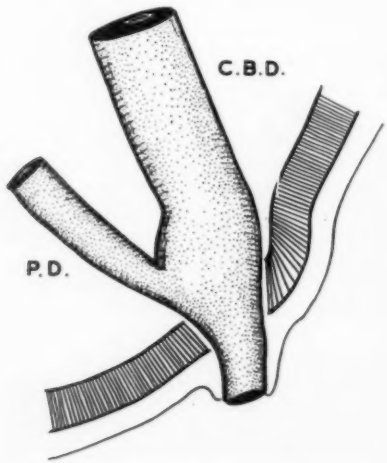

FIG. IV. The common bile duct and pancreatic duct unite just outside the duodenum. Undissected there is no evidence of any abrupt narrowing of the lumina of the ducts.

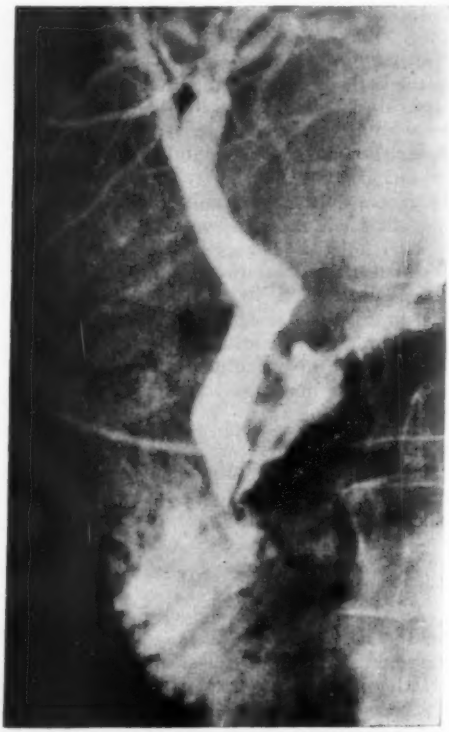

FIG. III. Operative cholangiogram demonstrating the narrowed intramural portions of both the common bile duct and pancreatic duct of Wirsung.

As the ducts course distally in this segment they are very narrow, particularly the pancreatic duct; the latter always lies medial to and below the common bile duct. There has been a very wide variation in the published

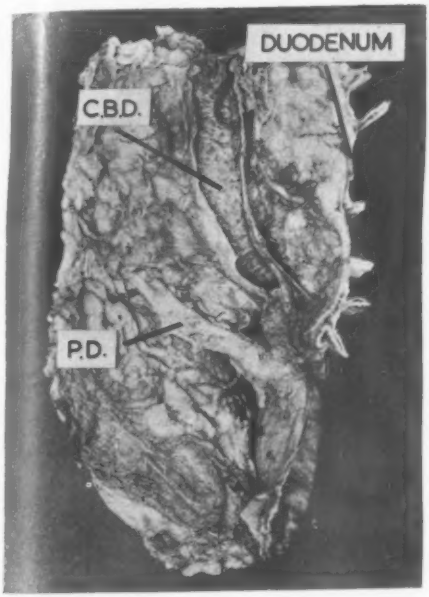

FIG. V. Photograph of a partially dissected specimen to show the union of the pancreatic and bile ducts just outside the duodenal wall. No indication of the abrupt narrowing of the lumen of the ducts is apparent until the ducts have been opened and traced distally. (In this specimen pancreatic tissue separates the common bile duct from the duodenum in the whole of its length.)

figures dealing with the exact relation of the orifices of the pancreatic and common bile ducts. Reviewing this aspect, Millbourn (1950) listed 23 authors who showed the widest discrepancy in their findings. For example, Job (1926) was only able to find an ampulla or common channel in 8 of 150 specimens examined, whilst Opie (1903) found an ampulla in 89 of 100 specimens dissected by him. Mann and Giordano (1923) examined 200 specimens and found an ampulla in 40, and Cameron and Noble (1924) observed a common duct in 74 of their 100 cases. Millbourn (1944, 1950) studied the problem radiologically; he tied a ligature around the apex of the papilla and then injected radio-opaque material into the common bile duct. He observed a reflux up the pancreatic duct in 85.5 per cent. of his specimens, and concluded that a common channel or ampulla existed in these.

FIG. VI. Photograph of specimen to show the V-shaped septum which separates the intramural portion of the two ducts. The sudden narrowing of the common bile duct is apparent. The last 10 mm. of the pancreatic portion of the common bile duct is in close contact with the duodenal wall.

The high incidence of reflux observed by Millbourn (1950) in his excellent and painstaking research and the wide variation in the observations published by others is probably due to defects in the septum between the ducts, which was apparent in the series reported here, and which have been taken into account by some and overlooked by others. Ivy and Gibbs (1952) in a study of the problems presented by pancreatitis, reviewed the literature concerning the aetiological significance of reflux of bile into the pancreatic duct, and came to the conclusion that separate orifices for the two ducts exist in 30 per cent. of cases, and a common ampulla in 70 per cent. In the 30 dissections analysed in this paper, 19 exhibited an ampulla, whilst in 11 there was none (Fig. VII).

The length of the ampulla when present varies in length, but is usually less than 5 mm. Schwegler and Boyden (1937) studied the development of the ampulla of Vater in a

FIG. VII. The relation of the terminal portion of the common bile duct and pancreatic duct of Wirsung

A. Ducts remain separate, and the septum may project through the papillary orifice (11 cases).

B. Ducts have a common orifice and a common channel which is usually less than 5 mm. in length (13 cases).

C. The common channel may be longer, and up to 12 mm. in length (6 cases).

series of embryos and found that at an early stage of development the ampulla was quite long, but shortened as the embryo enlarged. Mann and Giordano (1923) observed in 76 per cent. of their specimens that the ampulla was 2 mm. or less, and in the remainder ranged up to 10 mm. In Baldwin's series (1911) in 14 specimens out of the 70 possessing an ampulla its length was 2 mm. or less. Cameron and Noble (1924) found the average length of the ampulla to be about 5 or 6 mm.; in 9 specimens of their 74 the ampulla was longer than 10 mm., and once in the 30 dissections reported here as before was an ampulla found longer than 10 mm.

The bile duct and the pancreatic duct of Wirsung finally terminate at the apex of the duodenal papilla. This duodenal papilla, designated the major duodenal papilla to distinguish it from the smaller or minor papilla which marks the orifice of the duct of Santorini, is always present although its degree of prominence varies. Baldwin was able to identify both papillae in each of his 100 cases; the minor papilla was present in all but three of the 30 dissections of this series, and it is quite possible that in these three the papilla was removed during dissection. The minor papilla was always proximal, and always ventral in position with respect to the major papilla (Baldwin, 1911; Cordier and Ansac, 1952) (Fig. VIII). The distance between the two papillae in this series averaged 21 mm. Plueckhahn (1953), in 125 consecu-

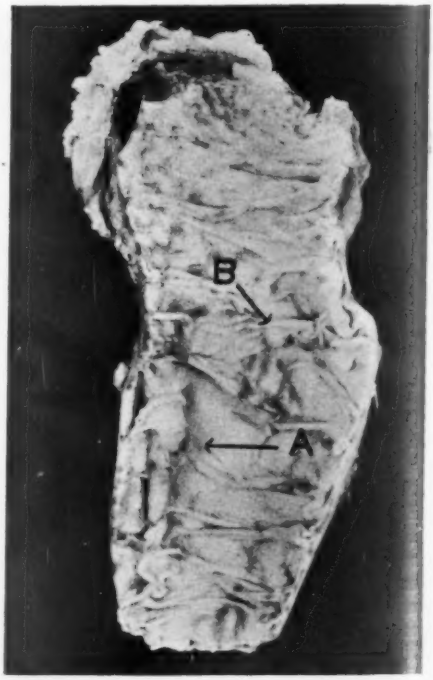

FIG. VIII. The mucosal aspect of the second part of the duodenum in a partially dissected specimen.

A. Major duodenal papilla.

B. Minor duodenal papilla (proximal and ventral).

tive post-mortem examinations, found that the average distance between the pylorus and major duodenal papilla to be 9.7 mm. The major papilla lies at the proximal end of a thin mucosal fold, 1 to 3 cm. long, and sometimes the bulging intramural course of the terminal portions of the ducts can be seen. Although no special attempt has been made in this investigation to study the relation of the folds traversing the duodenal mucosa the pattern observed corresponded with that described in text books.

At the level of the duodenal papilla, Baldwin (1911) observed a distinct bulging or hollowing out of the duodenal wall towards the head of the pancreas. In 7 specimens of the series analysed in this paper this bulging amounted to a distinct diverticulum into which the papilla may open but usually it is found to one side, most commonly on the ventral aspect of the diverticulum. Two further cases contained a duodenal diverticulum, but in neither case having any relation to the major duodenal papilla. Odgers (1930) and recently Chitambar (1953) reviewed the literature on duodenal diverticulosis and both observed the frequency with which these diverticula were related to the duodenal papilla, recalling the older terminology of "peri-vaterian diverticulum" (Figs. IX, X, XI).

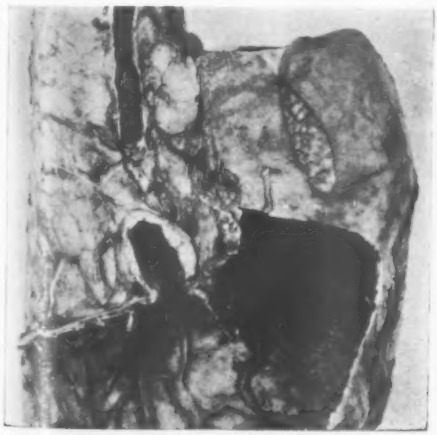

FIG. IX. A diverticulum of the duodenum in close relation to the major duodenal papilla. In this specimen the diverticulum is on the dorsal aspect of the ducts.

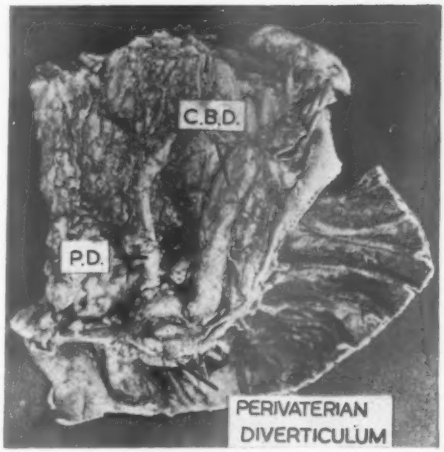

FIG. X. A duodenal diverticulum (peri-vaterian diverticulum) on the ventral aspect of the ducts and which has slightly deviated their course.

FIG. XI. A duodenal diverticulum in the second part of the duodenum.

CLINICAL SIGNIFICANCE OF THE ANATOMICAL FINDINGS

Gall-stones entering the common bile duct gravitate to the distal portion af the duct, and come to lodge immediately proximal to the intramural part (Fig. XII). There is evidence to show that such stones may remain in the

duct for years without causing symptoms. Stones in this situation, particularly if the orifice leading to the intramural portion, be eccentrically placed, need not necessarily cause jaundice, and because this terminal portion is invariably covered by pancreatic tissue it is unlikely that even the most meticulous palpation will reveal them. If stones enter the intramural segment of the common duct they will almost certainly cause obstruction to biliary flow, although only temporarily in most cases; if they become tightly wedged in the terminal segment of the pancreatic part of the common bile duct, or in the intramural portion they will be responsible for obstructive jaundice.

FIG. XII. A gall-stone in the lower end of the common bile duct.

Opie (1901) believed that a calculous impacted in the ampulla of Vater caused reflux of bile up the pancreatic duct with subsequent pancreatitis. To account for cases of pancreatitis occurring in the absence of biliary calculi Archibald (1919) postulated that a similar obstructive effect would be produced by spasm of the sphincter of Oddi. The present investigation has shown that the two ducts practically always terminate together, but in one-third of specimens the ducts are separated by a septum which is usually complete and may project through the papillary orifice into the duodenum. In the remaining cases a common channel exists but is short; it is usually so short that a stone passing into the papillary portion of the common duct would cause biliary and pancreatic obstruction rather than biliary reflux. The investigations of Hendrickson (1898), Boyden (1937), Kreilkamp and Boyden (1940), Thiessen (1941), and others indicate that the musculature around the ampullary portion is either absent or imperfect in five of every six adults. Contraction of the sphincter of Oddi is more likely to obstruct the bile duct and sometimes the pancreatic duct, but rarely would it cause the ducts to become a closed common channel. Furthermore reflux of bile into the pancreatic duct is probably a normal event in many individuals; films taken in operative cholangiography show that reflux of the medium into the pancreatic duct is not uncommon and Millbourn (1950) noted its occurrence in individual published reports as varying from 7 per cent. to 47 per cent. Pancreatitis is a condition which presumably has a number of different causes; the present investigation indicates the ease with which a biliary calculus may obstruct the pancreatic duct by pressure on the septum separating the two ducts (Fig. XIII). The practice of some surgeons of placing one long arm of a T tube through the intramural portion of the common bile duct into the duodenum is open to the same objection. The duct of Santorini can take over the function of drainage of the pancreas after obstruction of the duct of Wirsung, but in a number of cases such compensation seems impossible (Millbourn, 1950).

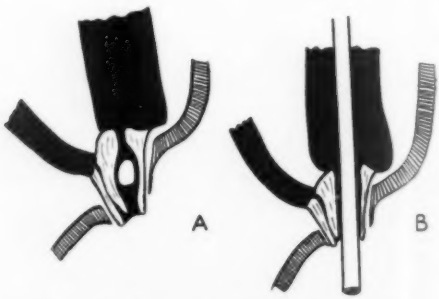

FIG. XIII. Obstruction to the pancreatic duct may be produced by:

A. A biliary calculus in the intramural portion of the common bile duct.

B. A tube passing through the intramural portion of the common bile duct.

Fibrosis of the sphincter of Oddi, also referred to as odditis stenosans (Feroldi, 1915), has attracted some attention and Trommald and Seabrook (1950), Partington (1952), and Cole and Grove (1952) have reported

cases. In one such case studied by Partington (1952) the sphincter was observed to be a firm cylinder of tissue measuring roughly 2 cm. by 0.5 cm. with a lumen which would admit only a probe; on section of the sphincter the walls were firm, grayish white and approximately 2.5 mm. thick. In the present series of specimens the longest intramural segment was 25 mm. and the maximum width, 10 mm.; and specimens sectioned when fresh frequently possessed grayish white walls. The diagnosis of such an ill-defined lesion macroscopically is unsatisfactory; and it is even less satisfactory to endeavour to localize the fibrosis to one or other duct orifice. In each of the specimens examined casual inspection suggests definite fibrous stricture formation of both pancreatic and bile ducts.

Biliary dyskinesia has been regarded by some as an important entity. It is postulated that symptoms may be caused in the absence of an organic lesion by spasm or functional inco-ordination of the sphincter of Oddi. Mallet-Guy and his associates (1951) have described a painful syndrome of the pancreas, similar to that of the biliary tract, and regarded by them as also caused by a functional disorder of the sphincter. All investigators concerned with the sphincter of Oddi have indicated that the chief muscular sphincter exists around the termination of the common bile duct, just outside or at the level of the duodenal musculature; furthermore Boyden and his associates have indicated that the weakest component of the sphincter is that surrounding the pancreatic duct at its junction with the bile duct. The present study has not been concerned with such functional lesions, but it has drawn attention to the sudden narrowing of the common bile duct at this level, simulating a tonic contraction of a sphincteric muscular ring; furthermore it has indicated that as the duodenum fills there is no reflux up the bile duct or pancreatic duct, presumably due to the "flap-valve" effect of an oblique passage of the ducts through the duodenal wall, an effect helped, perhaps, by the foliated nature of the mucous membrane.

RADIOLOGICAL SIGNIFICANCE OF THE ANATOMICAL FINDINGS

One of the most controversial features of operative cholangiography is the difficulty of interpretation of the films. Most confusion is encountered in the identification of abnormalities at the lower end of the common bile duct. The shadow cast by the medium filling the common bile duct tapers abruptly at the lower end to continue as a slightly tortuous and narrow pathway into the duodenum. The medium normally enters the duodenum without delay, and its presence here may increase the possibility of error by partly overlapping the terminal common bile duct shadow.

In most instances gall-stones appear as filling defects, and are to be found in that part of the common duct just proximal to the narrowed intramural segment (Fig. XIV). Very small stones may not be detected at all, although if the film be closely studied their presence may be revealed by indentations on the edge of the shadow thrown by the bile duct just before it narrows. A very large stone impacted in this part of the duct prevents any filling of the lower duct and may be respon-

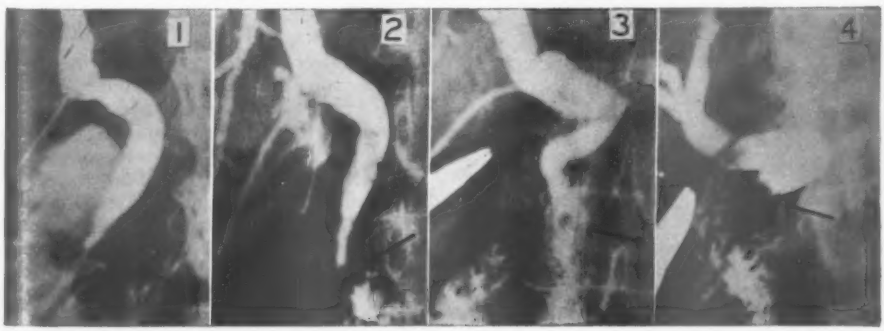

FIG. XIV. Operative cholangiograms demonstrate:
1 and 2. Narrowing of the common bile duct just outside the duodenal wall.
3 and 4. Filling defect caused by a calculus in the distal part of the common bile duct.

sible for an abrupt concave termination of the bile duct shadow. A stone impacted in the intramural portion of the common duct interferes with entry of the dye into the duodenum and an absent or minimal shadow within the duodenum will make the surgeon suspicious.

The radiological diagnosis of stricture in the ampullary region should be made with caution because, as indicated above, there is an abrupt diminution of the calibre of the lumen (Fig. XIV). Indeed many of the films published to demonstrate stenosis of the bile duct at this level actually appear to be within normal limits. The diagnosis of hypertonic and atonic sphincters by these means presents great difficulties which have been overcome by Mirizzi (1948) through experience and by Mallet-Guy (1947) with the help of manometry.

FIG. XV. A gall-stone in the terminal common bile duct might evade removal by the usual methods.

SURGICAL SIGNIFICANCE OF THE ANATOMICAL FINDINGS

Although apparently effective in a high proportion of cases, removal of stones by means of supraduodenal choledochotomy is not a reliable procedure (Millbourn, 1950; Hughes, to be published). Stones can be extracted by scoops and with forceps if they lie in the common bile duct proximal to the intramural portion of the duct; but this investigation has shown that the duct has a tendency to form shallow pockets at this level and it is reasonable to assume that a stone impacted here could escape detection (Fig. XV). A stone impacted in the narrow lumen of the intramural portion is probably pushed into the duodenum by the point of the probe. A probe can usually be manipulated into the duodenum but sometimes the surgeon is deceived; the tip of the probe lodges in the common bile duct in juxta-position to the duodenum, although the surgeon might believe that it has slipped into the duodenum (Fig. XVI).

FIG. XVI. A probe may give the false impression of having passed through the intramural segment into the duodenum.

Stones impacted in the intramural portion of the common duct can be freed after duodenotomy by a simple incision placed over the stone, a procedure first performed by McBurney in 1891 (McBurney, 1898). The papilla is steadied and lifted into prominence by passing a sound along the duct and elevating its distal end. If the stone be impacted in the common bile duct just above the duodenal portion it can usually be released from its position by manipulation from above and below, but occasionally the stone defies such efforts and the surgeon may be forced to approach it through the duodenal wall. Kocher, in 1894, was the first to recommend removal of these stones by this route. This investigation has shown that the common bile duct usually lies in intimate relation to the duodenal wall for at least 10 mm. proximal to its entry into the duodenum; above this level pancreatic tissue together with an arterial arcade may lie between the common bile duct

and duodenum so that Kocher's manoeuvre demands caution (Fig. XVII).

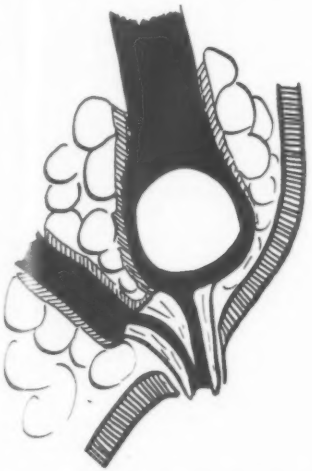

FIG. XVII. A large stone impacted in the terminal end of the common bile duct may require removal by direct incision of the tissues over the stone; pancreatic tissue may intervene.

Division of the sphincter of Oddi has been advocated from time to time. Colp, Doubilet and Gerber (1936) introduced a "sphincterotome" which is passed down the common duct through a supraduodenal incision and which is designed to cut the sphincter of Oddi. A blind operation such as this is not particularly suited to this region because of the variable length of the intramural portion of the common bile duct and hence the impossibility of performing a sphincterotomy with any accuracy. Transduodenal sphincterotomy is a more accurate procedure because the muscular division is performed under direct vision after the duodenum has been opened.

However, the results that have been obtained with sphincterotomy have varied widely. Colp (1946) reported symptomatic relief in 7 of 8 patients treated by "endo-choledochal sphincterotomy" and Major and Ottenheimer (1953) claimed a cure in 20 of 23 patients treated by transduodenal sphincterotomy. On the other hand, Kjaegaard (1953) dealt with 12 cases of post-operative biliary dyskinesia by this latter method but only 4 seemed to have been improved.

Such discrepancy in the results can be understood if considered in conjunction with the anatomical findings reported here. The nature of pathological disturbances in this region, and their effects, are still very poorly defined, and hence individual interpretation of the indications for sphincterotomy will

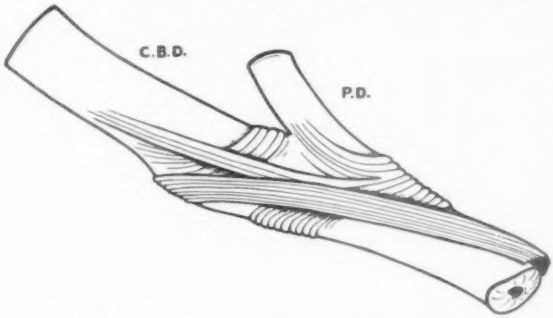

FIG. XVIII. The sphincter of Oddi (modified from Hendrickson). The muscular sphincter is best developed around the common bile duct.

vary widely. Furthermore, the anatomical extent of the sphincter of Oddi is such that complete division of the muscle would entail in many cases perforating the duodenal wall

FIG. XIX. Post-operative cholangiogram following an apparently complete sphincterotomy to show that some degree of narrowing persists at the lower end of the common duct indicating persistence of muscular tissue at this site.

on its pancreatic aspect; this might pass undetected and prove dangerous (Figs. XVIII, XIX). And finally, although Doubilet and Mulholland (1948) believed that retraction of the dividend sphincter muscle rendered postoperative stricture formation unlikely, some of the poor results may well be due to stenosis developing as the result of the formation of granulation tissue at the site of the incision prior to epithelialization of the cut surfaces; this would be expected to occur unless the mucosa of the duodenum be sutured to the mucosa of the ampulla over the divided sphincter muscle (Ochsner, 1948). This principle of mucosa to mucosa apposition would seem even more important in cases of fibrosis of the ampulla.

SUMMARY

1. The terminal portions of the common bile duct and pancreatic duct of Wirsung have been dissected in 30 formalin hardened specimens. Observations have also been made on some specimens whilst still fresh.

2. The common bile duct approached the duodenum obliquely in 26 cases; in 7 of these the duct was separated from the duodenum by pancreatic tissue throughout the whole of its length, whilst in 19 the duct came into intimate relation with the duodenum for a length of 10 to 15 mm. just prior to its junction with the pancreatic duct of Wirsung. In 4 cases the common bile duct was closely related to the duodenum throughout the whole of its length.

3. As it approached the duodenum, the pancreatic duct pursued a course roughly parallel to the common bile duct and it lay a little deeper in the pancreas.

4. The two ducts joined 2 mm. to 10 mm. outside the duodenal wall and became enveloped in a common adventitial sheath. The lumina of the ducts did not become confluent at this level, but for a varying distance they were separated by a thin V-shaped septum. This septum completely separated the two ducts in all instances and in some cases actually projected beyond the papilla. In the other 19 cases the septum was shorter so that a common channel existed. The septum was often incomplete at its distal end, and the variation in published observations on the presence or absence of a common channel may be due to recognition or otherwise of the incompleteness of the septum. The length of the common channel when present was usually less than 5 mm.

   The combined intramural ducts formed an indurated cord which varied from 6 mm. to 25 mm. in length and averaged 6.3 mm. in diameter.

5. The lumen of both ducts showed an abrupt narrowing at the level at which the walls of the ducts became contiguous just outside the duodenum. The common bile duct narrowed abruptly from an average diameter of 8.5 mm. to a slit-like channel and this often resulted in a shallow pocket in the common bile duct at this level, and related to the duodenum in 16 cases.

6. The major duodenal papilla was always present. In no case did the common bile duct and pancreatic duct of Wirsung possess separate papillae. A minor duodenal papilla was visible for the pancreatic duct of Santorini in 27 of the 30 specimens.

7. In 7 of the 30 specimens a diverticulum of the duodenum was related to the major duodenal papilla. This has been referred to in the past as a "peri-vaterian diverticulum". In 2 other cases duodenal diverticula were present, but not in relation to the major duodenal papilla.

8. Gall-stones in the common bile duct are most commonly found just proximal to the narrow intramural portion and are apparently able to remain here for long periods without ill effect. If the stone enters the intramural portion it may obstruct the pancreatic duct by pressure on the thin V-shaped papillary septum. Pancreatic duct obstruction appears more likely to be a factor in pancreatitis than reflux up the duct.

10. An operative diagnosis of fibrosis of the sphincter of Oddi must be accepted with caution. Functional disorders of the sphincter are more likely to affect the common bile duct than the pancreatic duct.

11. Operative cholangiography is criticised in some clinics because of the difficulty in interpretation of the films. Confusion is most apparent at the lower end of the common bile duct and this anatomical study has directed attention to some of the difficulties.

12. Removal of gall-stones from the lower end of the common bile duct is usually accomplished without difficulty, but in some cases stones are overlooked and the anatomical reasons for this are discussed.

13. Operative division of the sphincter of Oddi is associated with variable results. This is due to an uncertainty regarding pathology, an incomplete sphincter division, and possibly to post-operative stenosis at the site of the sphincterotomy.

ACKNOWLEDGEMENTS

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A MALIGNANT MELANOMA OF THE CHOROID OCULI

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THE malignant melanoma of the choroid is a common neoplasm in the eye. The tumour mass is usually visible through the pupil and of a typical appearance. While the cells usually conform histologically to one pattern, less commonly two cell types are present.

The eye described here is of interest, not only because of the diverse pathological changes present, but also because of the alternatives in clinical diagnosis and the methods used to establish this.

CLINICAL HISTORY

The patient, a male aged 56, presented in October, 1952. He had noticed that the vision in his left eye had been gradually diminishing for several months but, because of the remoteness of his place of employment, had delayed consulting anyone about it until a week before presenting, when the eye had become intermittently painful.

When examined, his right eye was normal, the anterior chamber was of average depth and the vision 6/6.

The left eye showed vision of counting fingers at half a metre; the projection of light was rapid and accurate. The cornea showed some fine oedema of the epithelium and an early arcus senilis. The anterior chamber was a little less deep than that of the right eye, the pupil was 2 mm. greater in diameter than the right and reacted very sluggishly to light. The reflex from the pupil area was very dull because of the corneal oedema and gave little information. The intra-ocular pressure was raised to 50 mm. of mercury (Schiotz).

Transillumination showed a dull light in the pupil area when directed through the sclera from all quadrants, similar to that seen in the average case of acute glaucoma.

The instillation of eserine sulphate into the conjunctival sac reduced the size of the pupil somewhat, but the cornea remained hazy and no view of the fundus was obtained; the intra-ocular pressure was reduced to 35 mm. of mercury (Schiotz).

No clinical sign was present which would enable a differentiation to be made between a glaucoma secondary to the presence of an intra-ocular neoplasm and a subacute glaucoma simplex.

To further the diagnosis, four days after the patient had presented, an iris inclusion operation was performed at the 12 o'clock position under local anaesthesia, the medial limb of the iris being included in the anterior scleral wound.

On the fourth post-operative day, the cornea was clear. The lens was quite transparent and a view of the fundus revealed a dark mass posteriorly. The overall transillumination did not equal that seen in the other eye.

The diagnosis of malignant melanoma of the choroid could now be made with confidence on the ophthalmoscopic appearances. The eye, including 1 cm. of optic nerve, was enucleated on the following day.

The patient made an uneventful recovery and later was fitted with a satisfactory prosthesis in his deep socket.

PATHOLOGICAL APPEARANCES

The relevant features observed in this eye are shown in the accompanying illustrations.

The cornea is normal. The post-limbal incision is well-seen, with folding of the posterior flap of Descemet's membrane into the wound. The iris is flattened between the lens and the cornea, and is normal except in the operation area.

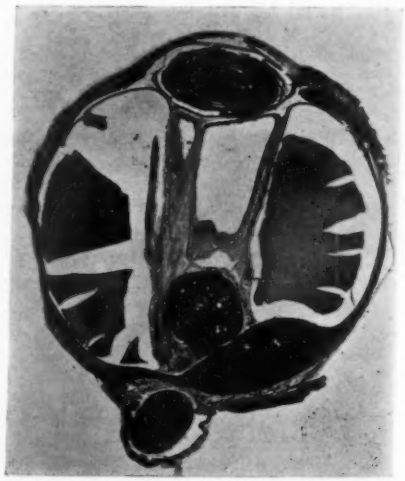

FIG. I. Photograph of a coronal section of the eye showing the filtration scar at the corneal margin, the tumour masses posteriorly, the infiltrated choroid and detached retina. (x 3)

The iridencleisis operation has resulted in a filtering cicatrix which, at the time of excision, had not formed those adhesions which enable the intra-ocular pressure to rise sufficiently to reform the anterior chamber. The retina is totally detached (seen in Fig. II, whilst arising posteriorly is a large, dark tumour mass. Anterior to this and in apposition is a lighter-coloured mass of tissue. Occupying the position of the choroid all around is a further thick layer of tissue, darkly pigmented and reaching as far forwards as the pars plana of the ciliary body.

FIG. II. Photomicrograph of the filtering cicatrix with open scleral section and included iris. (x 20)

The ciliary body shows infiltration on the side opposite the operation area up to a point 3 mm. in front of the ora serrata, this infiltration being furthest forward in the tissues immediately beneath the epithelium. Nearer the ora serrata the muscle fibres are separated by columns of cells.

The subretinal fluid has shrunken during preparation of the eye to give the irregular structure occupying most of the interior of the globe.

Fig. II shows the filtration cicatrix in higher magnification. The iris pigment in the subconjunctival tissues is well-seen, while

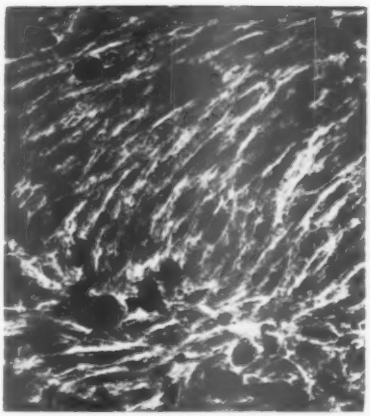

FIG. III. Photomicrograph of the posterior tumour cells showing their spindle shape and the presence of pigment granules. (x 120)

the aqueous fluid which has escaped through the incision, made through the anterior sclera for this purpose, has rendered the subconjunctival tissue oedematous. The lens overlies the incision, in its normal position after release of aqueous from the anterior chamber.

The tumour in contact with the sclera posteriorly is composed of whorls of spindle-shaped cells with large nuclei containing an open chromatin meshwork. A few blood spaces with ill-defined walls are present, and a golden-brown pigment is to be seen in irregular aggregations, mainly extra-cellularly placed (Fig. III).

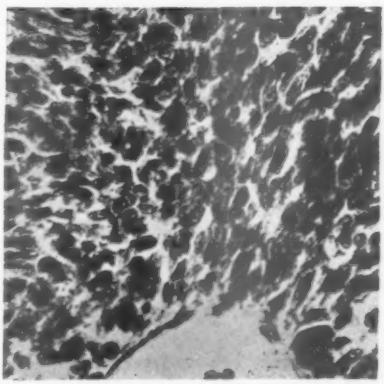

FIG. IV. Photomicrograph of the more anteriorly placed tumour which shows the epithelioid type of cell and a blood space. (x 120)

The more anteriorly and centrally placed tumour mass, separated from the larger posterior tumour mass by a layer of irregularly flattened cells, is composed of epithelioid-type cells with oval nuclei. The cells are not packed so closely together as in the first group and neither is there much pigment to be seen. The blood spaces are larger and appear to have a limiting membrane around them. These cells are shown in Fig. IV together with a blood space which has one pigment granule near its margin.

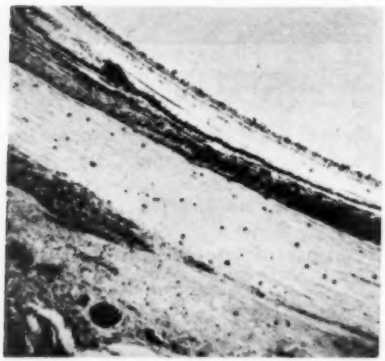

FIG. V. Photomicrograph of the anterior retinal area and ciliary body. The tumour cells are seen between the muscle bundles. (x 15)

The third group of cells has invaded the choroid, to form a thick black mass extending forwards and around the eye from the mass posteriorly (Figs. I and V). Fig. V shows the pigmented area ending anteriorly in the pars plana of the ciliary body. Fig. VI shows more clearly nearly the whole width of the infiltrated choroid with the retinal pigment cells to the top and the capillary blood vessels beneath Bruch's membrane which itself is not penetrated in any part. The main peripheral tumour mass is also well-seen, the cells are elongated with dark nuclei containing more chromatin than the posterior groups. Pigment granules are seen within the cells and very large pigment masses in extra-cellular positions are present in profusion. The normal choroidal chromatophores are difficult to find in this cell mass.

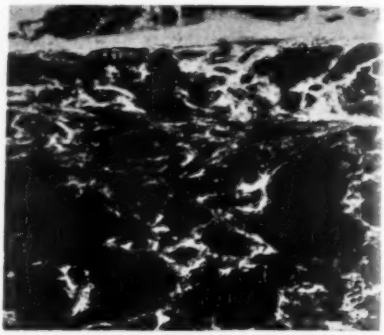

FIG. VI. Photomicrograph of the choroid laterally in the eye. The massive pigment granules are well-seen. (x 120)

Extra-ocular extension of the tumour has not occurred anteriorly, neither are there any tumour cells near the site of the decompression operation. However, the cells have penetrated the sclera at its thinnest portion, adjacent to the optic nerve, and are seen passing into the subarachnoid space surrounding the optic nerve in Fig. VII. Apart from these, no other tumour cells were seen around the optic nerve.

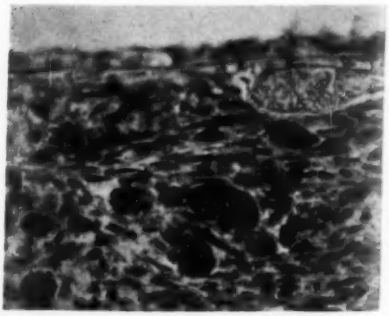

FIG. VII. Photomicrograph of a section of the choroid which has been partly bleached. The type of cell present shows more clearly than in Fig. VI. (x 120)

The tumour therefore is a malignant melanoma of the choroid showing no fewer than three distinct cell types, and combining the raised form with the infiltrating flat type. This is a very unusual occurrence and therefore worthy of note (Duke-Elder, 1940; Wolff, 1949). One may wonder what were

the intra-ocular events which determined the growth of these distinct cell masses and what were the chemical and environmental changes present at each stage.

FIG. VIII. Photomicrograph of the eye showing the tumour and sclera above, the optic nerve to the right and the subarachnoid space centrally and inferiorly. The penetrating tumour cells are seen at the top of this space. (x 15)

SUMMARY

(1) The pathological features of an eye containing an unusual malignant melanoma are described, this eye being of interest because of the nature of the tumour cells present, their positions and spread, and because of the presence of a filtration cicatrix following iridencleisis.

(2) The not uncommon problem of aetiology of an acute glaucoma is discussed.

(3) It is considered that further investigations, including decompression operation should be performed to establish the diagnosis of glaucoma secondary to malignant neoplasm in an eye in any doubtful case before excision is undertaken.

REFERENCES

DUKE-ELDER, Sir Stewart (1940), "Textbook of Ophthalmology." London: H. Kimpton, vol. 3, page 2477.

WOLFF, E. (1949), *Brit. J. Ophthal.*, vol. 33, page 445.

Books Reviewed.

SURGERY OF REPAIR AS APPLIED TO HAND INJURIES.

By B. K. RANK, M.S.(Melb.), F.R.C.S., F.R.A.C.S., and A. R. WAKEFIELD, M.S.(Melb.), F.R.C.S., F.R.A.C.S. Edinburgh: E. and S. Livingstone Ltd., 1953. 9¼" x 6¼", xiv plus 256 pp., 188 illustrations. Price: 40s. net.

In his foreword Sir Gordon Gordon-Taylor concludes that no reader "can fail to realise the impact of repair-minded surgery on the progress and advance of the science and art of Surgery itself." For this reason, this book should receive the close attention of surgeons no matter what be their surgical specialty. Every surgeon should be conversant with the repair of wounds, and although this book is concerned with injuries of the hand, the principles involved differ only in the finer details.

The book has been divided into five parts, the first of which is concerned with certain basic features. Hand injuries are common and their economic liabilities reach astonishing proportions; for these reasons the surgeon should be aware of his responsibility in advising Industry of ways and means of prevention. The chapter on surgical anatomy is unorthodox in that the classical approach with its detailed and often superfluous descriptions has been replaced by a much more useful and practical one in which most emphasis is placed on function, nerves and tendons. The third chapter of this first part deals with the organisation designed to give the injured hand maximum efficiency in treatment from the moment of the accident, and the fourth chapter with a scheme advocated for estimating the damage done to the hand prior to reparative surgery.

In the second part of the book the primary treatment of the injured hand is discussed. The authors have classified these injuries into "tidy" and "untidy" types. They are averse to any anaesthetic technique which increases the likelihood of bleeding, and for this reason have not been favourably impressed by closed circuit methods; local anaesthesia, unless its use is contra-indicated by the presence of infection, is invaluable. Formal, complete excision of the wounds is not practised; obviously devitalised and contaminated tissues are removed and ragged edges trimmed. The viability of tissues is carefully assessed and their dictum that "closure with non-viable tissue means failure and closure over non-viable tissue may be disastrous" will meet with the unqualified approval of surgeons. The practical surgeon will also appreciate the emphasis placed upon the initial dressings, the applications of which are so often relegated to the nursing staff. In discussing the method of closure of the wound, the authors have gone into detail on the construction of flaps because such techniques are, on the whole, poorly understood. If operating conditions are satisfactory and the surgeon skilled, they advocate primary repair of tendons and nerves. Professor H. J. Seddon is criticized for his preference for secondary suture of nerves but this is, perhaps, a little unjust, because Seddon's teaching may well have been prompted by a desire to take such important and time-consuming work out of the hands of those ill-equipped. Rank and Wakefield urge caution in treating extensor tendon injuries too light-heartedly.

The third part of the book deals with the intermediate treatment of the injured hand when primary repair has not been possible or has been inadequate. The authors admit that mistakes may be made by anyone, but if they are realised their ill-effects can be minimised. The surgeon must be actively engaged until the wound is healed—"The longer the wound remains unhealed or the longer a joint remains stiff or deformed, the more remote the possibilities of restoration to normality."

In the fourth part, the authors describe their methods in elective secondary repair which is only possible after the hand wound has healed and is in good condition for such surgery. Excision of scar tissue, tendon and nerve repair, and secondary procedures on bones and joints are discussed in detail. The remarkable results possible by painstaking reconstructive surgery are illustrated by clear photographs.

The fifth and final part of the book discusses certain special aspects of hand injury, the burnt hand in the treatment of which pressure dressings are favoured, hand injuries in children and hand prosthesis.

This book has been written by two surgeons renowned for their excellent work in surgery and in clinical instruction, and the quality of this publication is a just tribute to their thoroughness. There are 188 illustrations, mostly photographs which, with few exceptions, clearly demonstrate what is intended. The two colour photographs have been particularly well reproduced. There are few references quoted in the book, which is not surprising because the subject matter represents the views of the surgeons concerned and is not intended as a review of current literature. For the same reason, the book should be read as a whole and not in part. The work is a milestone in Australian Surgery, and is one which all under-graduates and post-graduates should possess.

Books Received.

BRITISH MEDICAL SCIENCE AND PRACTICE.

An Anthology. Arranged and edited by G. F. PETRIE, M.D. London: Longmans, Green & Co., 1953. 8½" x 5½", xvi plus 172 pp., frontispiece and 12 plates. Price: 15s. stg.

ALFRED HOSPITAL CLINICAL REPORTS, VOLUME 3.

Alfred Hospital (Inc.). Melbourne, Vic., 1953. 10" x 6¼", 116 pp., illustrated.